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• **Installing pipe** in coal mines is an everyday occurrence in most operations, but "floating" 8-in. cement-lined cast-iron pipe in a vertical borehole to carry water, with two smaller diameters for cables, is another story. Howard Thomas, general superintendent, Alta Coal Co., and associated Alabama companies, will detail the method used in placing these pipes in the 304-ft. boreholes in an early issue.

• **Unique** is truly an apt description of the methods employed by Snow Hill in opening its new Fayette No. 4 mine. To obviate new shops or a railroad haul, a 1,550-ton bin was built underground for the No. 4 output, which is fed into Talleydale No. 3 cars for hoisting and preparation on the second shift. Why this system and how it works is told in this issue, p. 44.

• **"Cash-and-carry"** truck mines are growing in importance to their communities and States as improved methods of production and preparation are installed and utilized. The story of scraper stripping to a depth of 50 ft., with two-bench power loading and cleaning as practiced at Hillside Coal Co.'s mine at Zanesville, Ohio, will be told in an early issue.

• **Two mining meetings** developed subjects of major importance to the industry last month and the reviews in this issue make interesting reading. The how and why of Princess Colliery (Cape Breton) slope-rope accident last year was fully presented and rope inspection and maintenance practices laid down at the Mining Society of Nova Scotia gathering, p. 60; while rubber-tired haulage, safety and the Federal Mine Inspection bill were the features discussed at the Rocky Mountain Institute meeting, p. 66, this issue.

• **Stripping operations** to produce maximum tonnage for a market area demanding both lump and stoker sizes at the Broken Arrow No. 4 mine of the Seneca Coal & Coke Co., near Tulsa, Okla., will be detailed in an early issue of Coal Age. With average overburden of 30 ft. to a seam thickness of 11/2 ft., maximum efficiency is the rule at this 1,600-ton property.

Part of the Sinclair haulage fleet (see p. 39)

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COAL AGE

Established 1911—McGraw-Hill Publishing Company, Inc.

DEVOTED TO THE OPERATING, TECHNICAL AND BUSINESS PROBLEMS OF THE COAL-MINING INDUSTRY

SYDNEY A. HALE, *Editor*

August, 1939

Pertinent and Impertinent

• BOTH the coal and public-utility industries score a notable victory in Congressional earmarking of how TVA funds should be spent. One victory, however, does not necessarily win a war. Those whom Representative May calls "the pied pipers of subsidized federal hydro-electric power" have not vanished. Private enterprise must continue on guard lest Congress again give ear to their siren strains.

• CONFISCATION complaints generally are based on the allegation that prices fixed by a duly authorized government agency are non-compensatory. A new twist, however, is threatened by some of the proposed bituminous minimum-price schedules. Unless these are modified before final adoption, the courts may be called upon to decide whether compelling a producer to charge too high a price is not also confiscatory.

• BROWSING through the lengthy "Rules and Regulations for the Marketing of Bituminous Coal," issued by the defunct National Bituminous Coal Commission and still official unless and until Secretary Ickes decrees otherwise, is not without its rewards. Sections V and VI, for example, specify that, if coal is sold for consumption or processing, it shall be used in the plant or plants named in the order or contract and for the use therein stated. If such coal is used otherwise, the buyer must notify the seller in writing and must pay "not less than the applicable minimum price for such coal in effect at the time of such change in application for the use to which it is actually applied." Who's being regulated now—producer or consumer?

• KUDOS to Harold Spear, of Koppers, for his research suggestions at the 1939 convention of the Stoker Manufacturers' Association. Mr. Spear kicked off with eighteen hard-pan proposals. All of them were good, but No. 16, which treads heavily upon sensitive toes, should be shouted from the housetops. "Assist," he said, "in making coal-burning equipment more completely automatic." Great strides, it is true, have been made in that direction, but, with competition what it is, neither the coal nor the stoker industry can long afford to have a large part of this equipment still only semi-automatic.

• TELLING the world the conditions under which miners work should be a part of a sound public-relations program. Most people not directly connected with the industry have a hazy idea based on conditions which existed a century ago. Many who sweltered and baked above ground during the July heat wave would have envied instead of pitied the toiler in the cool coal mine—had they known!

• MECHANICAL LOADING is making such rapid progress that it is becoming increasingly difficult to justify its avoidance in some form. More and more management is asserting that "we must mechanize if we want to stay in business." And more and more mines are abandoning

hand loading. Each such abandonment makes the path of the non-mechanized mine that much harder. Business on crutches has slim chance in today's swift competitive race.

• PRESIDENT ROOSEVELT'S edict to WPA workers that "you cannot strike against the government" inevitably brings to mind Calvin Coolidge's telegram of twenty years ago in the Boston police strike. Is this a sign that F. D. R. contemplates further emulation of his predecessor—in such things, say, as taxation, spending and budget balancing?

• EMPLOYEES of large coal-carrying railroads are beginning to realize the point repeatedly stressed by the National Coal Association that decline in coal tonnage jeopardized railroad job security. The Railroad Employees and Tax Payers' Association of Richmond, Va., already has distributed several thousand copies of a leaflet urging railroad and express workers to become missionaries in reconverting back to coal local householders who have shifted to oil. If this is not done, the organization points out, drastic curtailment of railroad employment is inescapable.

Why, Uncle!

OLD PREJUDICES die hard. And nowhere, apparently, more reluctantly than in some of the agencies of our own Uncle Samuel. When mechanization first appeared on the horizon, safety men attached to the U. S. Bureau of Mines were naturally concerned with the new hazards the machine might introduce. No one should criticize them for that. But this concern at times threatens to become an obsession which leads them to belittle the facts disclosed in their own studies and investigations.

A recent analysis of accident-frequency rates in Illinois (Information Circular 7063) is a case in point. This study covers operations at 22 mines. A composite tabulation of 75 mine-years of operation in 100 per cent hand-loading mines shows a frequency rate of 156 and 6,378 man-hours of exposure per lost-time accident. The composite for 100 per cent mechanical-loading mines, representing 81 mine-years of operation, shows a frequency rate of 92 and 10,766 man-hours of exposure per lost-time accident. Fatality frequency rates are 1.16 for the handloading and 1.15 for the mechanized mines.

But what comment has the report to make on the lower frequency rate for mechanized operations? That company and employee interest in safety in recent years has been much greater "than was ever shown before mechanical loading was introduced." If such interest had been manifested before, continues the survey, "the accident rate of hand loading would have been very much lower." The closer supervision inherent in mechanization, mentioned earlier in the report, is blandly ignored in this summation.

Welcome Notes

FOR MORE than a decade, the coal industry wallowed in pessimism and synthetic dispair. Bituminous spokesmen had the dubious honor of starting the keening, but in recent years their anthracite brethren have not been voiceless during the lamentations. Satisfying as this performance may have been to the troubled souls of the mourners, it has not raised the public standing of the industry. Neither has it improved its financial status—unless the Guffey mirage and the unsuccessful attempts to legislate the anthracite group into the prosperity of scarcity can be counted as improvements.

In the last few months, however, the beating of the drums has sounded less like the toll of a dead march. Continued survival under conditions so adverse that the timid could see no end but extinction has reawakened confidence in the future. Anthracite Industries, Inc., reciting its major accomplishments in 1937 and 1938, declares "both oil and gas now find anthracite heat an aggressive competitor and a definite barrier to their former easy-going progress."

Asked "how sick is the industry," John D. Battle, executive secretary, National Coal Association, retorts that "the bituminous coal industry is on the mend with a strong recovery in sight." These sentiments are reechoed by an increasing number of other leaders. Moreover, there is nothing Pollyannish in this changed attitude. It is taken without blinking at the many serious problems to be solved. Defeatism is again retreating before courage.

Flashing Milestones

NOT SO LONG AGO anybody who talked of 30 to 35 tons per man-shift for mechanical loading under favorable conditions risked being denounced as a dangerous visionary. But that seemingly impossible estimate now threatens to become ultra conservative. There were days in March when the Wick mine, in Indiana, with loaders and rubber-tired haulage, did better than 500 tons per machine-shift, or approximately 50 tons per man on the loading crew. And that when the haul was the longest and roof and bottom conditions were the worst. What was exceptional under those conditions is expected to be normal under favorable conditions at Wick.

New methods, new and improved equipment, and increasing skill in the application of existing facilities are all tools of progress in the hands of alert management. Machine capacity is still largely untested because of the toll of non-productive machine hours. Improved transportation already is materially lessening that toll. Scientific studies of roof control and support, the development of long faces far beyond the accepted maximums of today promise to cut these non-productive hours still further. In the light of this and in the face of the Wick record and advances made at other efficient operations throughout the country, who can say what the ultimate will be?

FIRST OF THREE ARTICLES ON STEEL SUPPORTS IN MINES

STEEL ARCHES AND RINGS

+ Justified by Years of Experience

By DR. R. G. WUERKER
Consulting Engineer
Manila, P. I.

EUROPE has made radical changes in its timbering methods during recent years; wood, brickwork and concrete have been replaced by steel. For this, the main reasons, in some cases, were a lack of sufficient and inexpensive timber, especially during the World War, and the evident failure of wood, brick and concrete to withstand the increasing pressures to which in European coal mines they are subjected. European mines are not only much deeper than in America but they have intermediate strata composed only of slate and shale, and seam worked under seam, so that extremely heavy rock pressures thereby result.

Ever since steel was first produced it has been used in places as a gangway support in mines. As far back as 1869, cast-iron arches were introduced, but these, of course, could not be successful. A little later, old mine rails bent into arch shape were used, and in 1875 this type of steel support was replaced by the so-called *tuerstock,* a set having two wood legs and a steel crossbar resting on them.

Then came the all-steel set, and even today some collieries have no supports other than these. At one mine, 18,000 short tons of such sets have been installed, corresponding to a consumption of 500 lb. per yard of heading. After the War, mining operations went to greater depths and heavier rock pressures had to be met; roadways also were widened. Concentration of workings to a few, but heavily producing, longwall faces required longer roadways of increased cross-section which had to be maintained for an extended period and in a more perfect condition than hitherto had been customary.

For a while, around 1920, it seemed that concrete and reinforced-concrete linings would take the place of wood- or steel-timber sets, but, for reasons too lengthy to detail here, they never will be able to resist the pressures existing in European coal mines. At least it is certain that they cannot, with economy, be constructed to carry such loads.

• Dr. R. G. Wuerker, former consulting engineer at the Stahlwerks-Verband A.G., Duesseldorf, Germany, presents three articles on the use of steel in coal mines for support of roof, of which this is the first. Dr. Wuerker, who played a part in the introduction in Germany of steel supports, is also author of many publications on the theory and application of steel underground. He was graduated as mining engineer from the School of Technology, Berlin, and several years later received the degree of Doctor of Engineering from the School of Technology, Aachen. From 1935 to 1937 he was connected with gold mines in Korea. Transferring to the Philippines in the latter year, he acted as consulting engineer and received an appointment as lecturer in the department of mining of the University of the Philippines.

In the meantime, better knowledge of the rock pressures in deep mines showed that the final type of steel timbering could be such only as would adapt itself closely to the natural outline of the excavation in rock and would be subject mainly to compressive stresses and slightly only to bending moments. In these respects, the square set is the least effective of all constructions. After trial installations of steel arches and rings and proof of their suitability to underground conditions in Great Britain and Germany and everywhere on the Continent had been obtained, these curved steel ribs came into general use in Europe.

Standard Types of Steel Supports —To make this change, a committee of mine operating men and steel manufacturers was formed by the Steelworks Association at Duesseldorf, Germany, which promptly submitted proposals for new girder sections, standard arches and rings.[1] These, in Germany as in Great Britain[2], cover straight-sided, horseshoe and slanting-leg types. In Germany, these arches are used mostly for rock roadways. The several arches range from a width of $8\frac{1}{2}$ to $15\frac{1}{4}$ ft. and are 7 ft. 10 in. high (Fig. 2). However, much bigger openings already have been supported by steel arches, as, for instance, certain shaft stations with $18\frac{1}{2}$ ft. of clear height (Fig. 5).

That the strength of arches and rings is superior to that of square

[1] *Stahl und Eisen,* Vol. 52, No. 38, p. 922 (English abstract in *Iron & Coal Trades Review,* Vol. 125, No. 3370, p. 509).

[2] British Engineering Standards Association Standard No. 227.

Fig. 1—Yielding steel rings with long-hole fishplates; two-track road.

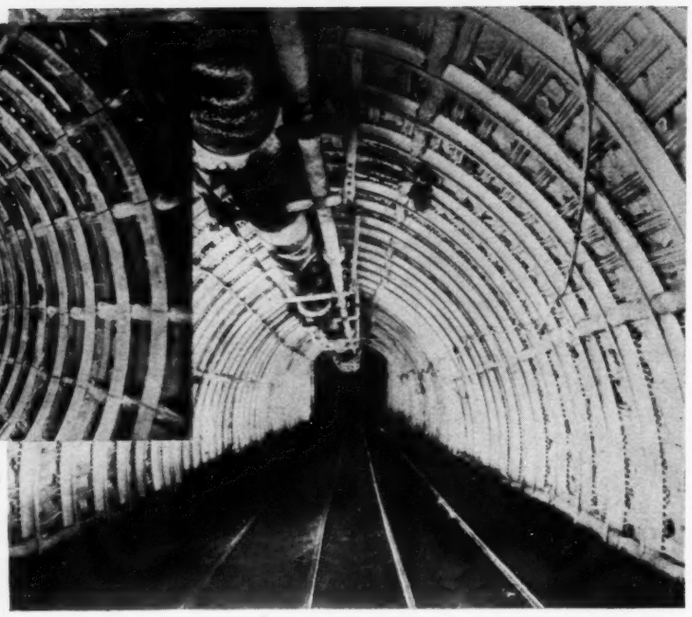


Fig. 2—Standard steel arches backed by corrugated steel-strap lagging; two-track road.

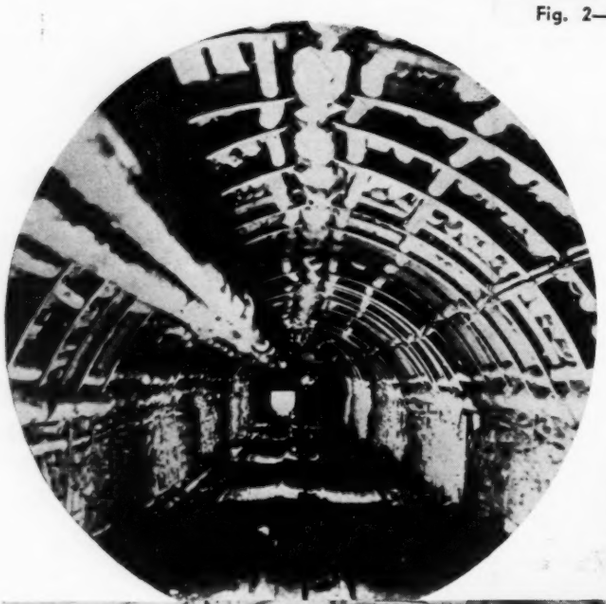
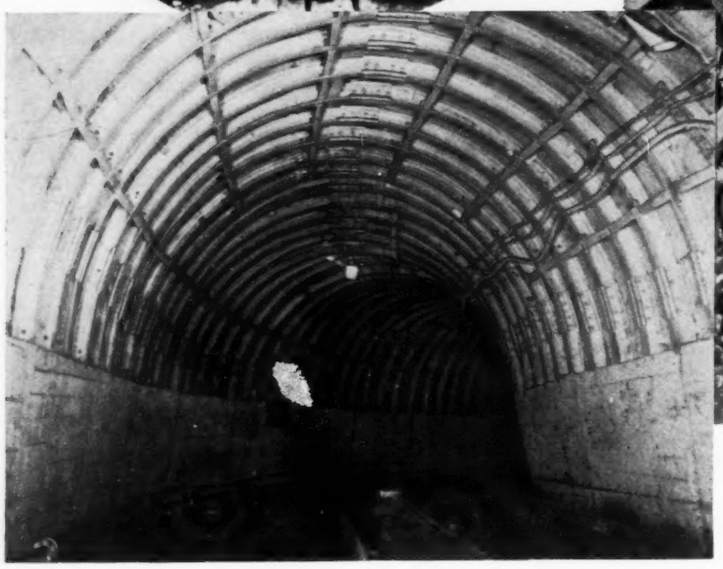


Fig. 3 (left)—Polygonal arch with continuous round timbers at crown and springing and stone packs for side walls; two-track road.

Fig. 4 (bottom, right)—Semi-arches for cross headings resting on cribs which are of the same height as the seam; single-track road with rubber belt.

Fig. 5 (bottom, left)—Steel arches at a shaft landing; clear height, 18½ ft. Note concrete covering of legs of arches to prevent displacement of latter should cars be derailed.



Photos courtesy Beratungsstelle fur Stahlverwendung, Dusseldorf, Germany

sets has been proved experimentally both in Germany and Great Britain, and calculation gives testimony to the same effect.[3] Using, for example, the same shape and size of steel girder, an arch would support three to five times and a ring ten times as great a weight as a steel set of *tuerstock* type. Furthermore, as the arch fits neatly into the natural lines of the rock, much less pressure will be imposed on the steel than with the square set.

For gangways driven in coal seams, special provisions have been made (Fig. 4). It is customary, when driving a level in seams with a dip under 30 deg., to remove coal and erect a strong crib on either side to support the steel arches. As the hanging wall cannot be kept from sagging, the cribs compress so as to let the weight down gently, and the semicircular arches have only to protect the roof from breakage. This construction has become quite popular.

Special Shapes Rolled

With the new arches and rings came a demand for special shapes. Formerly, standard I-beam, U-beam and H-beam sections, the last with an enlarged web, were in use, also old rails, and the old special mine-support shapes. Except the H-beam with thickened web, none of the aforementioned sections was found to be adequate for arches and rings, hence new special mine sections were rolled by nearly every steel mill (Fig. 6, *c, d, e*). The majority of manufacturers turned to type *d*; one big steel company to the asymmetrical "wine-glass girder" (*Coal Age*, June, 1932, p. 248).

As all the rolling mills make H-beams, it was easy to obtain these sections, slightly changed, however, by a thickening of the web. The section "Toussaint-Heintzmann" (*e*) was originally created for the steel mine prop of that name but was later adopted for rings and arches, for which purpose it was found suitable, particularly for those of yielding type. At present twenty new steel sections are available in depths from $3\frac{1}{8}$ to $6\frac{1}{2}$ in. and in weights from 34.651 to 109.5 lb. per yard.

To develop the full strength of the rigid arches, the joints must be equally strong. This is attained by using fishplates having the same depth as the girder section or, still better, a shape suitable for clamping.[1]

Polygon and Yielding Supports—The aforementioned supports, except the arch for level gangways, are of rigid construction. For timbering in swelling ground or in gangways driven in the coal, especially in mines with steep pitching beds, polygonal arches with four or more hinges and yielding frames are used. The former were introduced by the manufacturer Moll. Under heavy pressure they change their shape but not their circumference and are forced, furthermore, to lean always against side walls and roof, distributing the load evenly over the entire polygon. Especially have polygon arches with five hinges become popular (Fig. 3). Types of hinges vary greatly; about 30 of them are on the market.

Yielding sets are designed in accord with principles such as have been used in the manufacture of steel mine props. In soft ground and in levels, their use is preferable. The simplest form of yielding arch or ring is one in which long-holed fishplates are used to which pieces of wood are fitted to increase friction and resist premature movement (Fig. 1).

Other constructions are standard channels or sections of the Toussaint-Heintzmann type assembled in such a manner that two adjacent segments slide into each other when the rock pressure exceeds the resistance of the clamp band. But these yielding sets change only their circumference, not their shape. It has been found important to provide that the yielding point of these arches and rings will be near the breaking load of the rigid frame, and this figure can be calculated. Supports of this kind sometimes give way at much too small a load.

Maintenance—The cost of steel supports in many cases is considerable. For the aforementioned colliery with 18,000 tons of steel in arches and rings, an investment of about 1,600,000 RM, or $380,000 gold, had to be made. A careful maintenance program therefore has to be followed. Because local conditions vary, many means are provided for straightening deformed supports. The simplest is the portable press; then comes the transportable pneumatic straightener. Stationary presses may be erected at the shaft operated by the pressure of the water column from the pumps. Such deformed steel may be only cold-straightened, but sometimes it is brought to line after heating in furnaces, especially in Great Britain, but for this treatment the steel must be transported to the surface.

Special machinery for removing arches in abandoned roadways also has been devised. Not only is the removal of such steel a safety provision but its recovery also is profitable, even where damaged beyond repair, for the sections can be sold as scrap.

Economy—The economy of steel supports for roadways can be checked best by comparing timbering costs of all kinds of mines over a period of two years. The uniform outcome of such an inquiry is to ascertain that total timbering costs increase for a few years until the mine is saturated with steel; thereafter they decrease considerably.

Statistics—That steel timbering is superior to wood, brickwork or reinforced concrete is proved by the increased use of steel arches and rings. When, in 1934, the coal mines in the Saar district were returned to Germany, roadways had to be thor-

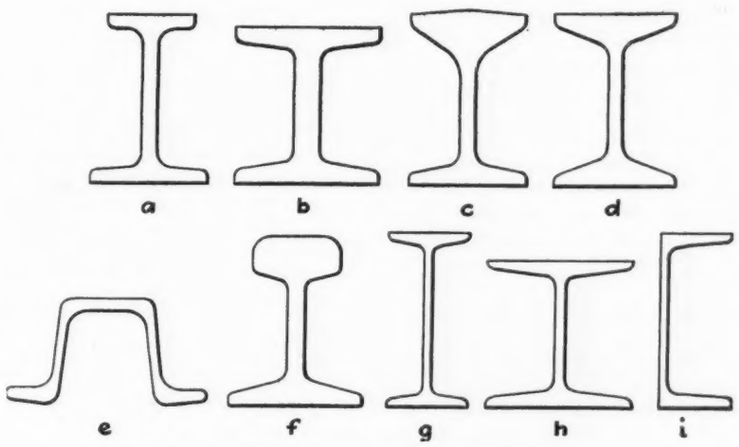


Fig. 6—Steel sections used for mine supports

(a) Old special mine section with unequal flanges, (b) special H-beam with enlarged web and flanges, (c) wine-glass girder, (d) special section for mine arches, (e) special section Toussaint-Heintzmann, (f) old rail, (g) standard I-beam, (h) standard H-beam, (i) standard channel.

[3] Wuerker, R. G.: "Streckenausbau mit Stahl," W. Ernst & Sohn, Berlin.

oughly overhauled. For the most part, steel support was chosen for gangways and headings, which is proof that the advocates of steel arches in earlier years were in the right.

The total quantity of steel required for roadway support can be estimated according to the length of roadways underground or to the annual coal production. The first gives an approximate figure for the tonnage already erected or to be erected in the future and the second a rough idea of the probable yearly consumption.

Great Britain, on June 30, 1937, had 2,908 miles of steel-arched roadways and 199 miles of cambered-steel roadways, according to the report of the (British) Chief Inspector of Mines[4]; M. H. Hudspeth and S. M. Dixon[5] estimated in 1934 that at the end of 1933 the length of roadways supported by steel arches was increasing annually 300 miles, and that of roadways supported by straight or cambered girders, 62 miles.

In 1934, an inquiry made in the Ruhr district of Germany elicited answers regarding 80 per cent of the coal production in that district, which is about 60 per cent of the production of all German coal mines. Summations showed that 729 miles of heading was supported by combined wood and steel timbering, 365 miles with steel supports only, 150 miles with timber and the 97 miles remaining with brick and concrete.

Steel consumption for arches, props, steel caps and lagging in Great Britain was estimated by Hudspeth and Dixon to be 4 lb. for each short ton of coal, which figure includes also sections used in repair. For arches alone the figure would be 3.32 lb. per ton. Should the consumption of steel arches and crossbars for newly driven roads be stopped, the annual consumption would be only 2 lb. per short ton, of which 1.37 lb. would be for arches. Consumption of steel relative to coal production is about the same in Germany as in Great Britain. No exact figures exist, but about 3 lb. of steel per short ton seems a fair estimate.

[4] Thirtieth Annual Report, H. M. Inspector of Mines, p. 187.

[5] "Steel Pit Props and Mine Arches," *Colliery Guardian*, Vol. 148, No. 3835, p. 1199-1203; *Iron & Coal Trades Review*, Vol. 128, No. 3460, p. 1005-1006; No. 3461, p. 1046.

FIRST AERIAL DISPOSAL PLANT

+ In the Anthracite Region Erected

By Glen Alden at Huber Breaker

By R. DAWSON HALL
Engineering Editor, Coal Age

• Aerial tramroads enable the Glen Alden Coal Co. to choose its own ground for rock disposal and to pile the rock 200 ft. deep without invading the city streets of Ashley Borough or the busy tracks of two railroads. No cost data are or yet can be given, but the method of handling —so new in Anthracitia—should be less expensive than disposal by other methods, even in those in which the rock is dumped all around the breaker, and the solution should serve for at least 30 years. Loss of control of the buckets, unevenness of bucket and tramcar loading, inequality of bucket spacing and spilling of rock used to be baffling problems, but in modern installations are so no more, for these uncertainties have been ironed out.

LOCATED between the Central Railroad of New Jersey and the main street of the Borough of Ashley, the Glen Alden Coal Co.'s Huber surface plant, near Wilkes-Barre, Pa., comprising breaker and power house, nevertheless found ample ground and to spare on which to locate all its accessories except a rock dump, always the most space-consuming of a mine plant's many adjuncts. To provide the necessary space, it has been found imperative to transport the mine rock and breaker waste by an aerial tram over the 25 tracks of the Jersey Central and the two tracks of the Lehigh Valley R.R. to a transfer bin, whence it is taken by one of two aerial trams to one of two dumps radiating from that point. These are the first aerial refuse and rock-disposal plants erected in the anthracite region.

Motor-truck haulage and conveyance by belt were proposed, but ultimately decision favored an aerial tramway as almost the only way of crossing the many tracks of the C.R.R. of N.J. where railroad cars are yarded prior to being hauled by ropes on the Ashley planes.

Breaker refuse is collected from the several picking tables, cone separators, etc., in the breaker and fed by gravity chutes to cross conveyors. These deposit the material on a main refuse conveyor that runs the full length of the breaker and discharges into a 12-ton hopper outside the building immediately over the first station on the aerial tramway, known as the "breaker loading terminal." Mine rock is deposited on the main scraper conveyor of the breaker and carried to a point near the east wall of the building, where a trap has been provided, permitting the mine rock to be discharged through a gravity chute to the refuse belt. Thus, the mine rock can be passed direct to the breaker loading terminal just mentioned without being handled by the breaker preparation machinery, though any coal mixed with the rock can be removed by hand.

The conveyor-type, or "continuous

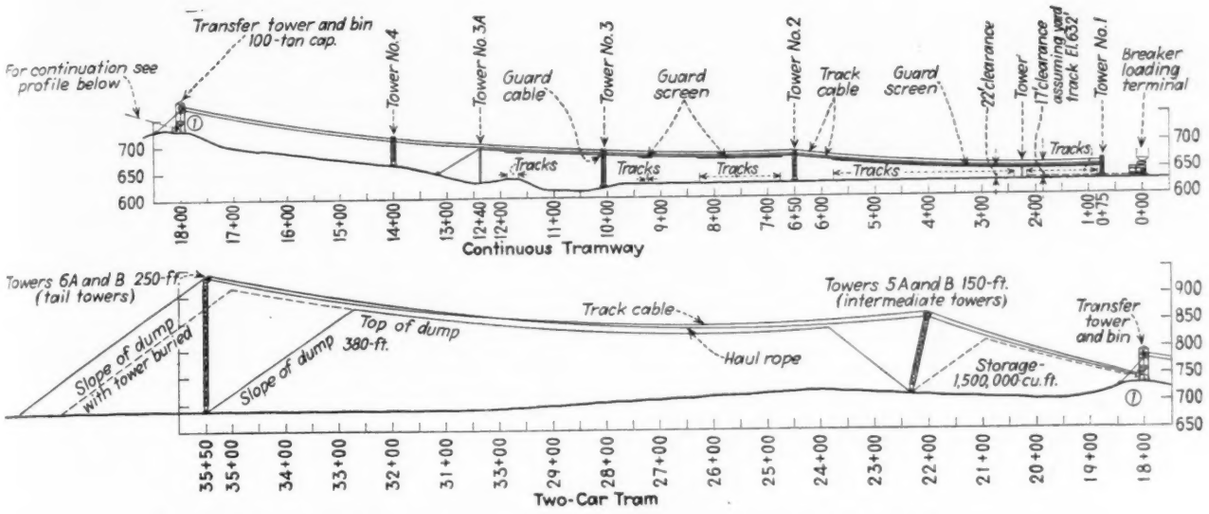


Fig. 1—Profiles of continuous and two-car tramways at Huber colliery; with full use of the space provided, 123,000,000 cu.ft. can be stored, or 80,000,000 between tail and intermediate towers, without encroaching on the towers themselves.

carrier," tramway, which is used for crossing the C.R.R. of N.J. and the L.V.R.R. tracks, consists of 22 four-wheeled shallow cars, or carriers, of 22.4 cu.ft. water-level capacity, traveling at wide intervals on two $1\frac{1}{4}$-in. lock-coil type cables which act as rails. These cables are supported at intervals by steel towers. The car wheels revolve on steel Timken-equipped axles and are grooved so as to bring the cables to the correct gage for their travel. A $\frac{5}{8}$-in. 6x19 plow-steel rope which is fastened to the bottom of each car at its center by an open and closed socket pulls the cars along the rope track. Cable links are 164 ft. long and, when coupled, become in effect an endless-rope haulage, driven at the discharge, or "transfer terminal," end of the continuous carrier tramway by a 76-in.-diameter tail sheave. This grip wheel is actuated through a helical steel gear and V-belt drive by a 30-hp. motor running at 900 r.p.m. Thus the cars are upended at the transfer station, upsetting the refuse into a bin; they return empty from the discharge to the loading point traveling along a pair of $\frac{3}{4}$-in. lock-coil track cables suspended immediately below the cables on which the same cars when loaded travel toward the transfer tower.

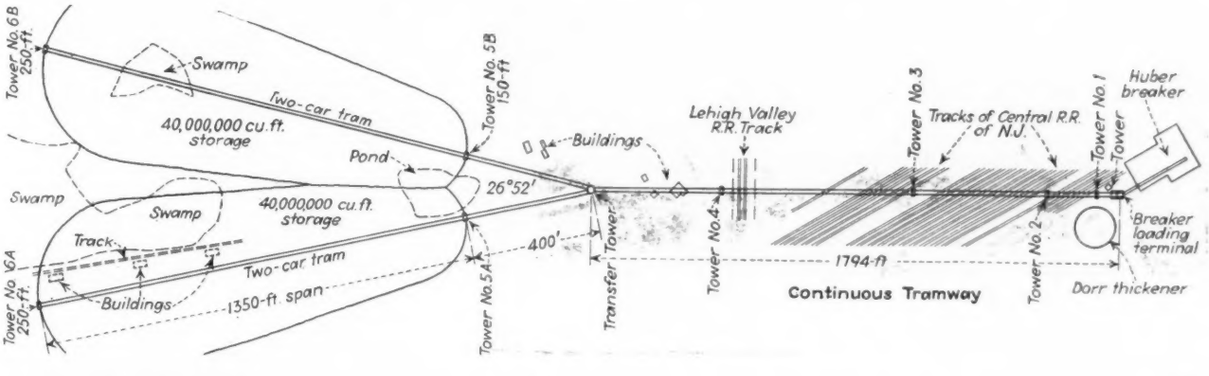
Four intermediate tower supports carry the conveyorway and, enumerating them in the direction of rock travel, these have heights of 33 ft. 4 in., 66 ft. 10 in., 69 ft. 10 in., and 59 ft. 4 in. respectively. At each tower, pivoted steel rocker saddles support the track cables and, between cars, the haulage rope passes over a steel idler sheave equipped with Timken roller bearings. These towers also support the four 1-in. galvanized steel cables by which a 2-in.-mesh steel screen—1,200 ft. long and 10 ft. wide—is carried over the railroads for their protection from falling material, if any.

Rectangular and about 60 in. long over all and 40 in. wide, the cars have a 51-in. track gage and a wheelbase of 54 in. They carry about a ton and move with a velocity of 400 ft. per minute—a speed that slightly exceeds that of a smart walking pace.

At the breaker loading terminal a reciprocating feeder driven by a $7\frac{1}{2}$-hp. General Electric gearmotor automatically feeds the carriers. As soon as the tramway circuit is energized, the feeder motor starts. So long as the hopper under the refuse conveyor contains the necessary refuse, the reciprocating plate feeder will load the required quantity into a counterweighted batch loader set immediately above the tramway terminal rails. The loader is mounted in a pivoted cradle and counterweighted so as to accept about 20 cu.ft. of refuse.

When this weight of material has

Fig. 2—Plan of disposal plant for breaker refuse and mine rock, showing dumps as they will appear when so far completed as to fill the spaces between tail and intermediate towers, but not beyond the tail towers, and between intermediate and transfer towers, which will hold in all 43,000,000 cu.ft. more.



been delivered to the loader, its cradle pivots, cutting off the feeder motor; then when the next incoming tramcar passes through the terminal it trips the loader and receives the required load. As soon as the tramcar passes the loader, a counterweight closes the loader door and the feeder again fills the loader, which cycle is repeated as long as the bin contains refuse. A switch stops the tramway when the bin is empty.

At this breaker loading terminal a device provides for collection of possible spillage, feeding the latter through a gravity chute to a skip bucket operated on an automatic cycle by a 7½-hp. gearmotor. When a predetermined quantity of refuse has been delivered to the skip bucket, its weight causes it to descend far enough to trip the starting switch of its motor, causing the skip car to rise and dump its load back into the main refuse bin. A reversing contactor at the top of the bin then reverses the motor and causes the bucket to return to loading position.

At the transfer terminal, the continuous-carrier tramway discharges its burdens into a 2,500-cu.ft.-capacity cylindrical steel bin with conical bottom. A reciprocating plate feeder of the same size as the unit at the breaker loading terminal discharges into a movable loader of 120-cu.ft. capacity. The feeder is equipped with an adjustable counting device, which may be set so that the feeder will load a predetermined volume of refuse into the loader.

At the transfer tower, refuse may be taken in either one of two directions for dumping. To this end two separate bucketways are provided which at the transfer tower are only 13½ ft. apart but which diverge from each other at an angle of 26 deg. 52 min. The loader is arranged so that it can be moved from one bucketway to the other and thus be made to serve either. Power for this movement is a 1-hp. gearmotor controlled by limit switches at each end of the loader travel. The loader in turn discharges directly into either of the buckets, each of which holds 100 cu.-ft., water-level capacity. Bodies of the buckets are of aluminum-alloy plates reinforced by a structural-steel framework. Each bucket is equipped with six Timken roller-bearing all-steel wheels.

Both of the buckets move on their own 1¾-in. lock-coil track cables which are set at 60-in. track gage and are moved by a ¾-in. endless-haulage rope of modified Seale plow-steel construction, with an independent wire-rope center. They travel at an average speed of 900 ft. per minute (or about 10 miles per hour). Each bucket is equipped with a built-in adjustable tripping mechanism actuated by the movement of the car wheels which may be set to dump while in motion at any desired distance from the loading point.

As the buckets are large and have to rise in traveling to and over the dump about 150 ft. and do not run on an almost level track as do the cars in the continuous carrier tramway, a 100-hp. motor is used which runs at 900 r.p.m., operating through a V-belt drive and helical spur gear. The drum of the main drive is of 100-in. diameter.

Fig. 3—Continuous carrier tramway crossing two tracks of Lehigh Valley R.R. and 25 tracks of Central Railroad of New Jersey in middle ground with Huber breaker and power plant in rear. Note mesh steel screens over railroad tracks.

At the transfer terminal is the sole attendant on the entire system; his function is to operate the bucket tram much as a hoist operator handles a two-car skip hoist. Not only has he electrical controls but a hydraulic brake which is used in normal operation to restrain the movement of the bucket. A heavy-duty 100-hp. thrustor-operated motor-mounted brake also is provided, but for emergency duty only.

High Tail Towers Inevitable

Because the relatively flat contours at the rock-dump site do not furnish the usual elevated location on the end of the line, where, despite a somewhat low tower, generous dump height may be provided in the adjacent hollow, high "tail towers" had to be constructed so that two piles each containing 40,000,000 cu.ft. of refuse could be dumped, enough together to provide for 30 years' total refuse output. If the tail towers are permitted to be buried and rock is dumped between the transfer tower and the near-by intermediate towers, the capacity will be 123,000,000 cu.ft. even without shrinkage. Each of these towers is 250 ft. high and, though 8x8 ft. in cross-section, they rear themselves so high in the air that they appear quite slender. These lancelike structures are mounted on concrete foundations with a pivoted base. Intermediate towers between the terminal 250-ft. or tail towers and the transfer terminals are 150 ft. high and also are mounted on pivoted bases. Heavy guy stays keep them in place. The intermediate towers lean about 14 deg. from the vertical toward the transfer tower, so that they split the breakover angles that the cables make in passing over these towers from loading station to tail tower.

Daily production of refuse from the breaker is calculated to be about 600 tons, with possibly 200 to 300 tons of mine rock additional. As this latter usually is brought out after the day shift in the mine has completed its work, the tramway will normally operate from ten to twelve hours daily. However, to provide for contingencies it was planned to have a minimum hourly capacity of 125 tons.

All electric motors are operated by 440-volt 3-phase 60-cycle current. This tramway was put in service when the Huber breaker went into operation, Feb. 1 of this year. Contract was awarded to the Interstate Equipment Corporation, July 26, 1938, and the work was completed prior to Dec. 1 of that year.

[SECOND OF A SERIES OF ARTICLES ON COAL-RESEARCH ACTIVITIES]

COAL RESEARCH

+ At Carnegie Institute of Technology

By H. H. LOWRY
Director, Coal Research Laboratory

• Knowledge of what coal is and why it behaves as it does in various processes is still woefully meager. Not only should both the coal producer and the coal user support much additional research but they also should fully inform themselves of the little that is known. It is unfortunately true that in the United States, with the greatest coal production in the world, coal producers lag behind those of other nations in these respects. How the Coal Research Laboratory of Carnegie Tech is seeking to enrich this scant store of fundamental knowledge is here outlined by Dr. Lowry.

THE Coal Research Laboratory of Carnegie Institute of Technology—brain child of the late Dr. Thomas S. Baker and culmination of his efforts to develop a center of research in Pittsburgh—was established July 1, 1930, to carry out fundamental research on coal and its products. Support was guaranteed for five years by six large industrial organizations, the Buhl Foundation of Pittsburgh, and Carnegie Institute of Technology. Since 1936 support also has been received from over twenty coal companies, the National Coal Association, five railroads, and one chemical company. From the beginning the program and policies of the laboratory have been discussed with and approved by a technical committee representing the industrial sponsors. For the past nine years the technical staff has averaged sixteen full-time members. The average annual budget of the laboratory has been $80,000.

For its initial project the laboratory undertook the study of the mechanism of thermal decomposition of coal—a problem of fundamental importance, since in every commercial use coal is subjected to the action of heat. Individual scientists have been studying this question piecemeal, on many different coals, the past 30 years. The conflicting viewpoints which arose could not be reconciled, for there was no common ground on which to evaluate the results. For this reason the Coal Research Laboratory staff initially confined all work to a single coal from the Pittsburgh seam. Correlation of the results thus obtained in many separate investigations over a period of five years has reconciled many of the contradictions that previously existed and has suggested a definite, though as yet incomplete, picture of the general chemical nature of coal. This work also has elucidated, to some extent, the sequence of events that occur when coal is subjected to heat, although many details of the mechanism require further investigation. During the sixth year sufficient work was done on the Illinois No. 6, Pocahontas No. 3, and High Splint seams to demonstrate that the relationships observed with the Pittsburgh coal could be applied generally to other coals with only quantitative changes.

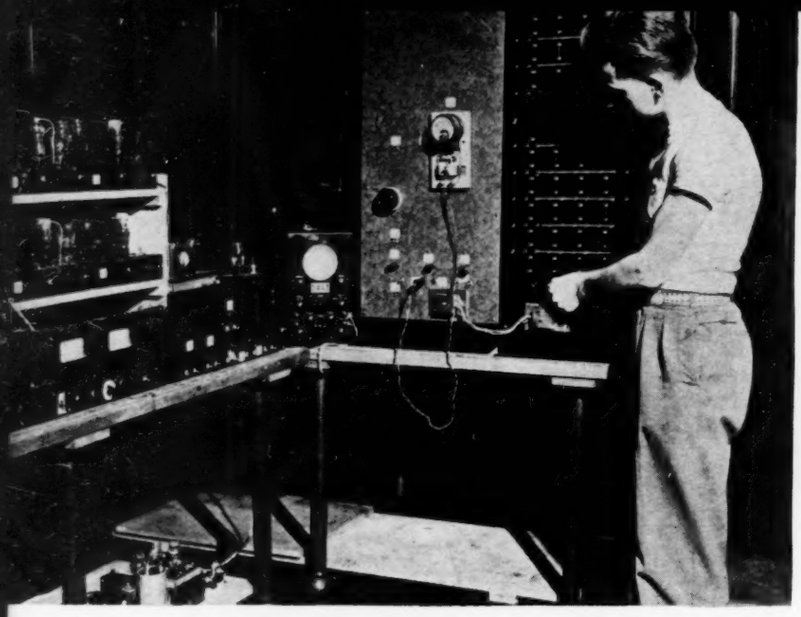
Merely by a shift in emphasis, some of the problems investigated in the study of the mechanism of thermal decomposition have developed into fundamental studies of combustion, carbonization, and hydrogenation of coal. The original problem involved a study of the chemical nature both of the coal and the products derived from it by the action of heat. One of the principal products is the solid residue from some coals known as "coke." One of the tests used to characterize coke has been the determination of "reactivity," although its significance in evaluating the "use value" of coke is still not completely understood.

A study of the many different reactivity tests proposed showed that in all of them apparatus factors partly determined the results; this explained how with different tests the rating of a series of cokes might vary. All these tests attempted to measure the rate of the chemical reaction between coke and an oxidizing atmosphere. A new method was devised to determine the reactivity first of monolithic graphite, then granular graphite, and finally granular coke, in which the effects of apparatus factors were eliminated. The method, however, proved too cumbersome and time-consuming for routine purposes.

While this investigation was being carried on, analyses of the mechanism of combustion and the ignition of solid fuels were simultaneously made. Analysis of the ignition process indicated that the reactivity of a solid fuel toward oxygen or air could be measured quickly by a modified ignition-point method. Apparatus and procedure were developed which satisfied the requirements of theory, and the reactivities of many cokes and coals have been determined. The apparatus is being duplicated in many laboratories in this country and abroad.

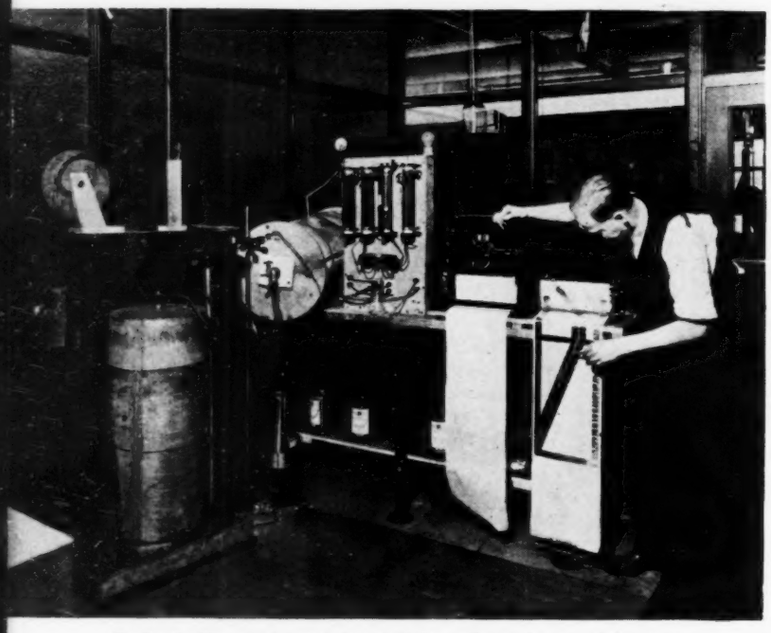
The Coal Research Laboratory study of reactivity has two objectives: (1) to determine on experimental cokes—prepared under carefully controlled and clearly defined conditions—how the reactivity of a coke depends on the original coal, on the temperature at which the coke is made, and on the rate of heating to final coking temperature; (2) to relate, if possible, the reactivities of series of commercial cokes and coals to their value in certain specific uses. In both studies the relation of reactivity to other chemical and physical properties also is being determined.

Analysis of the combustion process led to a mathematical theory by which temperatures and gas compositions in a fuel bed with pure under-



Part of an electrical analogue of a fuel bed by which effects on combustion of change in fuel feed, air rate, fuel reactivity and other variables can be determined in the laboratory.

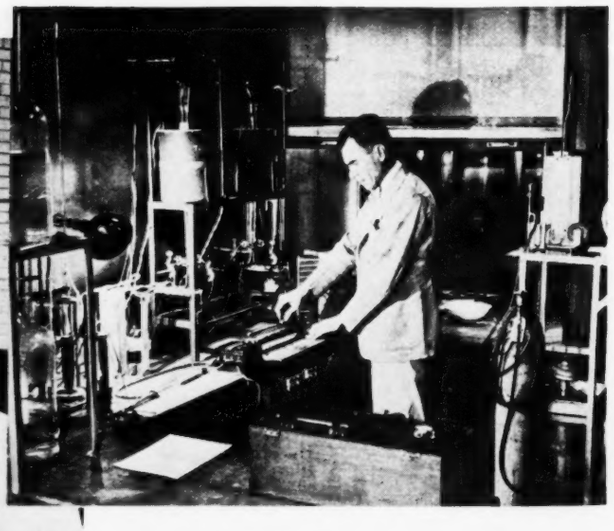
Microchemical balance room. Analytical work is all performed by micro-analytical techniques permitting use of small samples.

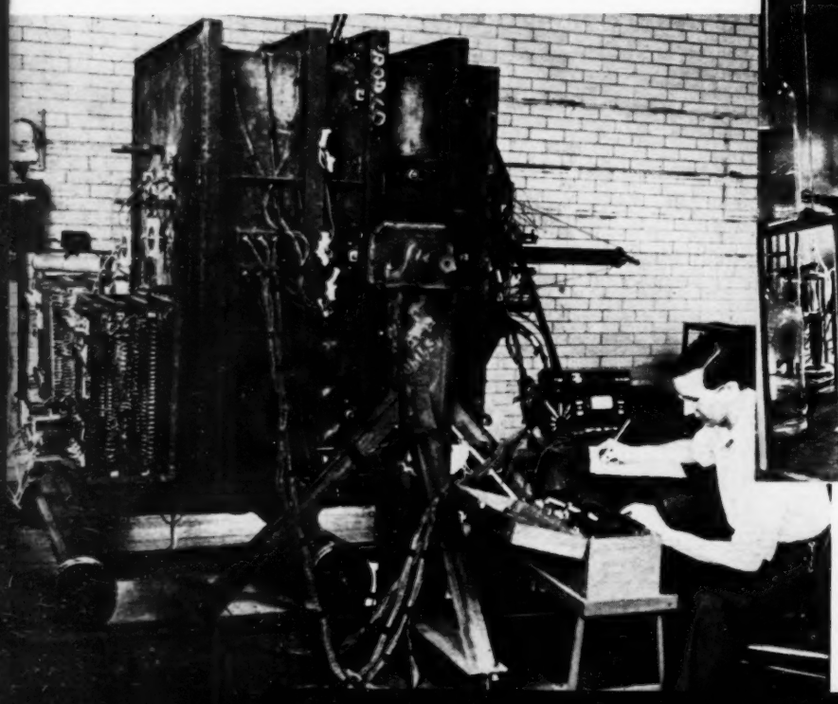


Carbonization equipment for studying effect of rate of heating on quantities and character of coke, tar, gas and liquor.

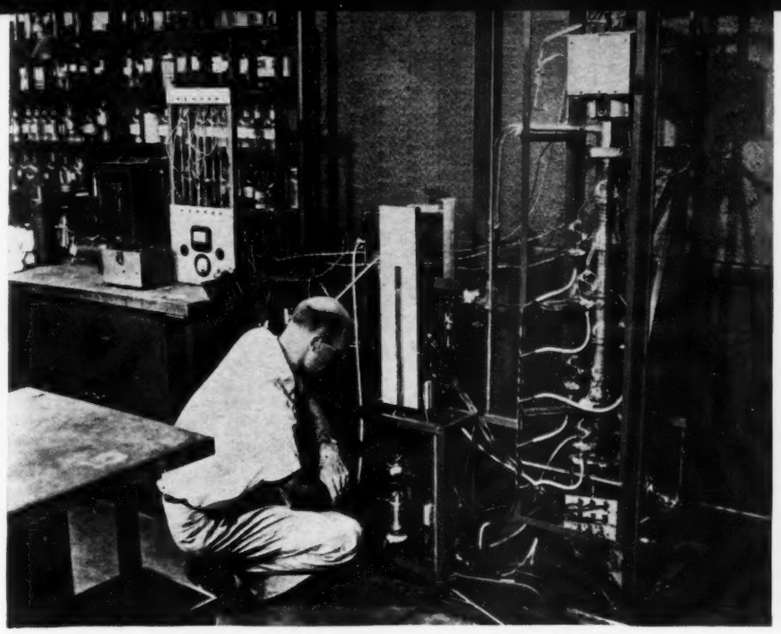
• Carnegie Tech Coal Research Laboratory owes its origin to the vision of the late Dr. Thomas S. Baker, president, Carnegie Institute of Technology, from 1922 to 1935. Established July 1, 1930, to carry out fundamental research on coal and its products, the laboratory represents the culmination of a program inaugurated in 1919 with a fellowship system in cooperation with a Mining Advisory Board and the U. S. Bureau of Mines. Results of this fellowship work have appeared in over 30 bulletins describing experimental studies in

Ignition-point apparatus for determining reactivities of solid fuels.





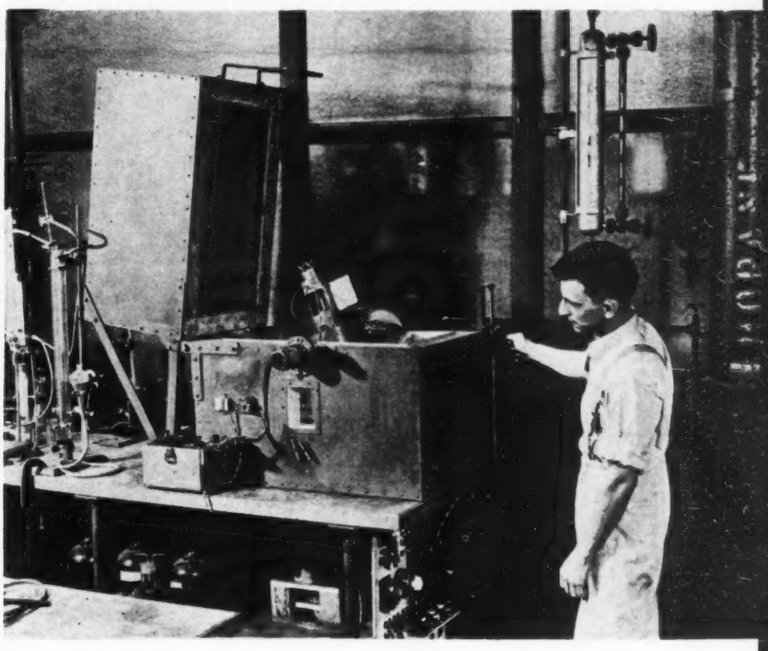
Experimental coke oven for measuring heat transfer into a charge of coal 12x12 in. with a depth ranging up to 12 in. Heater at left is bolted to coking chamber, which has a movable wall from which a ram extends to the right for measuring expansion. Cables in foreground come from thermocouples located at fixed points within the charge and at the heating face.



Molecular fractionation still operated at high vacuum for studying hydrogenation products from coal.

Entrance to two safety booths where high-pressure hydrogenation and oxidation reactions are carried out.

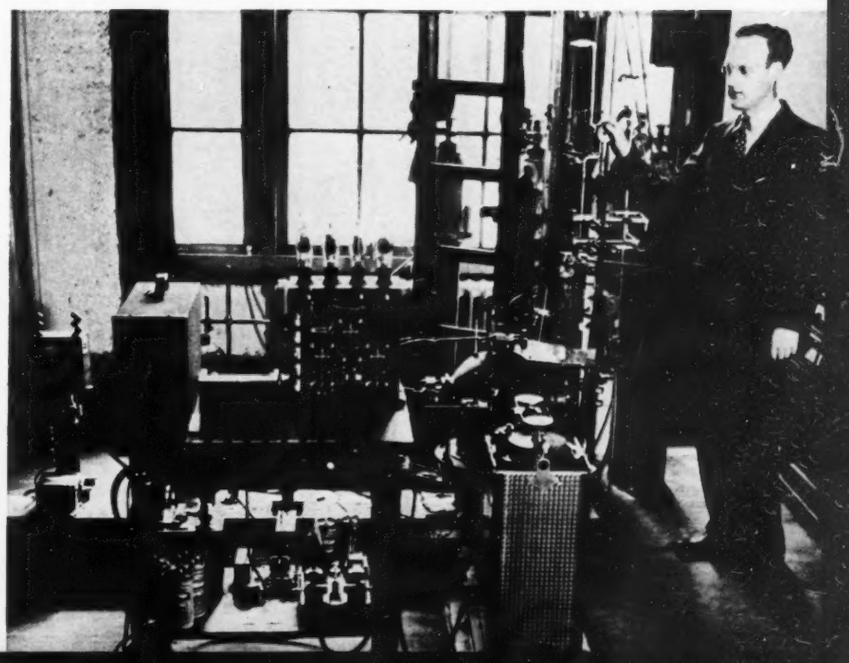
Pressure bomb and constant temperature box used in studying solvent action of propane on coal tar.



subjects such as carbonization, spontaneous combustion, rock-dusting, cleaning, petrography, pulverized-coal combustion, mine-car friction and blasting. The second major step in the Baker program was the organization of the International Conferences on Bituminous Coal, held in 1926, 1928 and 1931, and attended by delegates from all over the world. Proceedings of these conferences are regarded as the most important reference works on the technology of coal utilization. Now the Coal Research Laboratory carries the banner.

Thermocouple probe for measuring temperatures in a fuel bed used in Hell Gate generating station investigation.

Apparatus used in cooperative study with Bureau of Mines for investigation of mechanism of gaseous combustion.



feed burning could be calculated from fuel size, air rate, fuel feed, and other variables. Further application of the theory, however, required measurements of temperatures and gas compositions in a fuel bed of a large underfeed stoker under various operating conditions. Through the cooperation of the Consolidated Edison Co. and Bituminous Coal Research, Inc., with the Coal Research Laboratory, these data were obtained on Boiler No. 73 at the Hell Gate generating station in 1937 and 1938 at different ratings with a central Pennsylvania low-volatile and a West Virginia gas coal. While analysis of the data is not yet complete, the tests showed clearly that combustion on such a large underfeed stoker takes place in a manner quite different from that which had previously been assumed by combustion engineers. This has suggested modifications in stoker design which should greatly increase the rate of combustion per square foot of grate area.

Domestic Stoker Designed

One of the byproducts of the combustion studies is a novel design of a domestic stoker for which patent application has been made. Patents issued to the staff of the laboratory are assigned to the Institute, which, through its Mechanical Engineering Department, has agreed to undertake development of the stoker if funds are made available by the several organizations which have expressed interest in it.

Other combustion studies at the laboratory are concerned with the mechanism of combustion of pulverized coal and of volatile matter. The experimental program on the first of these should provide data to clear up inconsistencies and contradictions which have resulted from earlier investigations. A knowledge of the mechanism of combustion of the volatile matter should aid in more rational design of furnaces. Work on this problem, carried out in cooperation with the Bureau of Mines, is still in its early stages. Already information has been gained which may have practical significance in design of internal-combustion engines and in determining ignition probability of "safe" mine explosives. This study is a particularly good example of how fundamental research on one subject may contribute useful information to related fields.

Among the first studies undertaken directly concerned with carbonization was an investigation of the separate effects of rate of heating with maximum temperature on the products obtained from coal. These studies showed that the chemical changes undergone by coal at low temperatures—in some cases entirely below the softening temperature—were of great importance in determining the yields and qualities of the coke and tar obtained subsequently on heating to normal coking temperatures. This information, together with previously published data, indicated a possibility of modifying current carbonization practice to decrease the coking time by at least one-third, but this modification cannot be recommended until further information is obtained on the conditions which would prevail in a coke oven.

Examination showed that it was not feasible to make the necessary measurements in a full-scale coke oven, so an experimental oven has been built, designed to reproduce the conditions at one square foot of an oven wall. In the laboratory, variables may be changed singly, but this is not true in practice. The present work on an experimental coke oven is directed to the end that an understanding of the interrelationships of variables in practice may be obtained. The most important information needed is how heat is transferred from a hot wall to a coal charge as a function of the coal used, its density of packing, and moisture content, and how these variables affect the expansion of the charge. When this information has been obtained, the advantages of the modification of carbonization practice indicated by our earlier studies can be stated with certainty.

The phenolic constituents of coal tar are possibly the most valuable liquid byproducts of coal carbonization. Studies have been made on methods of separation and identification of the phenols in tar, and especially on the influence of carbonizing temperature on the yield of polyhydric phenols in tars from different coals. Use of propane in solvent refining of petroleum suggested that this solvent might also be of value in tar refining, and this possibility, too, has been the subject of an investigation.

From a chemical point of view, hydrogenation of coal is very complex. In the Coal Research Laboratory, studies of some of the factors affecting the over-all process are being made separately. The "primary" reaction of hydrogen and coal at low temperatures where severe cracking is limited has been investigated. Information of great significance has been obtained regarding the chemical nature of coal from a study of the reaction products. In commercial hydrogenation, coal is mixed with a liquid carrier to form a "paste." The liquid used undoubtedly exerts solvent action on the coal. For several years, the laboratory has been investigating the nature of solvent action on coal, studying with many solvents the effect of temperature on yield of extract.

Analysis of the data is not yet complete, although the information is consistent with the idea—developed in many of our other studies—that the first action of heat on coal is one of depolymerization. It seems probable that the first step in the hydrogenation is the reaction of hydrogen with the depolymerized units formed by the action of heat in the presence of the "pasting" liquid, or solvent. The hydrogen pressures used are high, ranging commercially from about 3,000 to 15,000 lb. per square inch. Equipment is being designed in the Coal Research Laboratory to study the hydrogenation at pressures up to 150,000 lb. per square inch. All these studies should contribute to a better understanding both of the chemical nature of coal and of how it may best be transformed into a desired liquid fuel.

Studying Hydrogenation

The action of hydrogen on coal at high temperatures removes the oxygen, nitrogen and sulphur of the coal and breaks the larger molecules into smaller ones which are the liquid or gaseous hydrocarbons obtained as products. There are other known reactions for removing oxygen from organic materials, and it seemed of interest to study one of them. The reaction of aqueous alkali on coal has not yet been fully explored but has yielded some interesting information. With this reagent, under certain conditions about 60 per cent of the oxygen can be removed with substantially no decrease in the hydrogen content. The product is readily hydrogenated and, because of its lower oxygen content, requires less hydrogen for a given end product.

In describing the work of the Coal Research Laboratory as related to combustion, carbonization, and hydrogenation of coal, it has not been possible to mention all the problems investigated. Much of the work of the laboratory has been more directly concerned with the chemical nature of coal and the action of heat on it. Only a part of the information so gained can be directly interpreted in terms applicable to commercial utilization of coal; it has value to the coal user and coal producer only to the extent that the information is used in improving operations or in development of new processes.

80-TON SEMI-TRAILER

+ Passes Tests With Butane Fuel

At Sinclair Strip Mines

• The Sinclair stripping organization numbers among its accomplishments the first use of tractor-trailer units on a major scale, starting with 6-ton semi-trailers in 1932. In February of this year, the organization put in service an 80-ton semi-trailer pulled by a two-engined butane-electric tractor. Savings are estimated at $6,000 per year. And in May, 1938, Sinclair started experiments with butane tractor fuel, which tests show gives about 18 per cent more power in addition to lower cost and other advantages. As a result, plans have been made to convert all Sinclair haulage units to butane this year.

By IVAN A. GIVEN
Associate Editor, Coal Age

THE FIRST to use tractor-trailer haulage on a major scale, the Sinclair stripping organization has been continuously active in the development of this medium of transportation since it adopted the automotive type of equipment nearly seven years ago. Starting with 6-ton units in 1932, capacity has been increased year by year to culminate last February in the installation of an 80-ton semi-trailer pulled by a two-engined butane-electric tractor equipped with two 125-hp. electric driving motors. This unit was placed at the Tiger mine of the Hume-Sinclair Coal Mining Co., Hume, Mo. Now under the supervision of T. L. Kelce, Tiger has been the Sinclair proving ground. It was here that the advantages of butane as a fuel were proved beyond doubt in 1938, with the result that it will be extended to all the organization's haulage units before the end of the year, according to present plans.

Trailers First Used in 1932

Sinclair went to automotive haulage with the opening of the Mark Twain mine of the Huntsville-Sinclair Mining Co., Huntsville, Mo.—Cecil Wilkinson now superintendent—where transportation with tractors and 6-ton United Iron Works Co. semi-trailers (still in service at the Broken Arrow properties) was inaugurated on June 1, 1932. In its initial effort, however, the organization chose to contract the Mark Twain haulage to Howard Asbell, now Sinclair truck superintendent, although it soon went into tractor-trailer haulage for itself, converting the rail-transportation systems at its existing operations and installing automotive equipment at all its new operations, including the Delta Coal Mining Co., Carrier Mills, Ill. (W. H. Price, superintendent); Sentry Coal Mining Co., Madisonville, Ky. (C. E. Mattox, superintendent), and the Broken Arrow No. 4 mine of the Seneca Coal & Coke Co., Catoosa, Okla., which, with Broken Arrow No. 2, near the town of the same name (C. M. Guthrie, superintendent), rounds out the Sinclair operating group. Forty-seven tractor-trailer units (Table I) delivering an average of 16,500 tons of raw coal to the tipple hoppers in seven hours were in operation at these six properties in February, 1939, although the number possibly will be reduced soon by replacements with larger units.

After the first tractors and trailers went to work, hardly a year elapsed before capacity was increased by the installation of 10-ton semi-trailers at Broken Arrow. These were followed at one or more of the various pits by 20-ton units in 1935,

Getting a load of about 75 tons of coal in the Tiger pit. This butane-electric tractor and semi-trailer, rated at 80 tons, has just turned in the space in front of the loading shovel.

Dumping 75 tons of coal at one crack at Tiger. In the rear are several smaller haulage units ranging in size from 16 to 25 tons.

25-ton units in 1936, 40-ton units in the fall of 1937 and the 80-ton job on Feb. 16, 1939. The tractor for the latter, however, was placed in service in October, 1938, pulling two 40-ton semi-trailers.

Automotive haulage was adopted for a number of reasons, of which a major one was elimination of the track and track shifting in the pit necessary with steam haulage—the difficulties and cost of which were increased by the thinness of the seams being loaded at several of the plants. The thinner the coal, the more territory covered by the loading shovel in getting a day's tonnage, with a corresponding increase in track laying and shifting. Greater flexibility in the transportation set-up, resulting in more continuous service to the loading shovel, and ability to reach isolated territories easily were other advantages, along with faster loading due to easier spotting of the automotive unit. The good roads necessary with tractors and trailers greatly increased the efficiency of supervision by providing a convenient all-weather access to the pit, while the ease with which men could be reached in case of injury was given major weight in the decision to change transportation mediums.

And while the above objectives were being realized in practice, experience also was demonstrating that automotive transportation equipment —both tractors and trailers—was relatively trouble-proof when regularly inspected and serviced, and operated over good roads. The latter, in fact, has been found the key both to greater output and reduced maintenance, not to mention longer tire life. With roads built as will be detailed below, the average tire life at the Sinclair properties since the first tractor-trailer equipment was installed has been 25,000 miles. About the only time Sinclair haulage units operate off a smooth-surfaced road is when they are on the coal.

The large semi-trailers installed to date at the Mark Twain and Tiger mines are from designs by Roy Houck, Tiger master mechanic, working under the direction of Merl C. Kelce, general superintendent of mines, and L. Russell Kelce, vice-president in charge of operations. First in the large-capacity group, as indicated above, was a 40-ton unit. Six of these now are in service at Mark Twain, which eventually will be equipped with these units entirely or possibly with a combination of 40- and 80-ton units.

Mechanical drop-bottom doors are installed on the 40-ton jobs, which are pulled by Dart 350 special tractors with two driving axles (Timken No. 462-W) in tandem. The tractors are powered with single Hercules "HXE" gasoline engines with Fuller 8A-860 eight-speed mechanical transmissions. With a fully loaded 40-ton semi-trailer, these units have a rated maximum speed of about 35 m.p.h. on the level. They actually operate over a 7- to 8-mile one-way haul to the new pit at Mark Twain at an average speed of 27 to 30 m.p.h. under normal conditions, dropping down to 15 to 16 m.p.h. on the 4.7-per-cent maximum grade on the main road. Average mileage is close to $1\frac{3}{4}$ per gallon of gasoline, which is about the figure that was obtained with the 15-ton units previously used in other pits at this operation. As noted above, gasoline will be replaced by butane.

The road to the new pit at Mark Twain epitomizes Sinclair standards for heavy traffic. It involved both heavy cutting and filling and the construction of three bridges across and adjacent to the Chariton River and one of its tributaries, as well as a county-road overpass, which brought the cost up to about $20,000 per mile, compared with the usual figure of $7,000 to $10,000 where no bridges and only normal cutting and filling are required. Located and engineered by the Sinclair engineering department, headed by R. C. Odell, this new main highway has a crowned roadway 45 ft. wide on top with a total width of 50 ft. Cut and fill on the job aggregated about 300,000 cu.yd., and one fill across the Chariton River bottoms 50 ft. wide at the top and 125 ft. at the base had an average depth of 14 ft. after compacting.

The main river bridge has a length of 90 ft. and is carried entirely on steel stringers. An overflow bridge consists of 54 ft. carried on steel with 20-ft. timber approaches, and a third bridge over Stinking Creek is identical with the overflow bridge. All three bridges were constructed on 45-ft.-long creosoted piles driven to the solid. Steel stringers consist of 6-ft.-deep I-beam sections from old railroad turntables. Floors are 4-in. oak plank laid on 6x8-in. oak crossbeams 14 ft. long. With guard rails at each side, bridge width is 12 ft. 8 in., as compared to 12-ft. centers for the stringers. The county-road overpass was another bridge job, in this case 128 ft. long.

Road Built With Dragline

Although the total haul to the new Mark Twain pit is considerably longer, new road totaled $3\frac{1}{2}$ miles. It was built with a dragline, which did both the cutting and filling, as well as the crowning, to make the subgrade. The shrinkage allowance on at least part of the fills was about 25 per cent. In building the subgrade, a 3-ft. ditch was dug out on each side. The subgrade then was smoothed off with a grader and compacted with an 8-ton roller, after which it was dressed with about 12 in. of crushed limestone. The bottom 8 in. consisted of crushed material with a top size of 2 in., while the top 4 in. had a maximum size of 1 in. The haulage units then were started on the road and operated over it for some two months to

compact it. During this period, the surface was kept in trim with a maintainer. After the road had been stabilized by traffic over this two-month period, it was oiled, using about ½ gal. of oil per square yard. This oiling is repeated at yearly intervals, and, aside from this and any necessary patching, no further attention is required. Construction practices at other Sinclair operations are substantially similar to the above except that rolling of the subgrade normally is omitted.

Welding was chosen by Mr. Houck for the construction of the 80-ton semi-trailer in service at Tiger. Like the 40-ton units, it has mechanical drop-bottom doors. Running gear was built by the Dart Truck Co., while the body was built and the unit assembled in the Tiger shops, as was the case with the 40-ton jobs. Final weight of the 80-ton unit, built of Bethlehem high-strength corrosion-resisting Mayari-R steel, was around 33,000 lb., compared with an estimated 45,000 lb. for plain carbon steel. Trailer dimensions are as follows: width, 12 ft.; length, 32 ft.; height above ground level, 11 ft. The rear end is carried on eight 13.50/24 20-ply tires (95 lb. per square inch air pressure) with a load-carrying capacity of 11,400 lb. each.

To pull the unit, Sinclair selected a special Dart 450E butane-electric tractor powered by two "HXE" engines, each with a bore of 5¾ in., a stroke of 6 in. and a displacement of 935 cu.in. With two such engines, displacement is 1,870 cu.in., giving a total brake horsepower of 396. Each engine, equipped with an Ensign butane carburetor, drives a General Electric d.c. generator, each of which in turn feeds a 125-hp. (net) electric motor, one for each of the two tandem driving axles. While originally designed for direct electrical drive, experience showed the desirability of a lower gear for emergency use (climbing short steep grades, etc.), with the result that a 2.27 to 1 mechanical transmission was added between the motors and the axles. Aside from infrequent use of this transmission, changes in speed are accomplished by varying the fuel feed by means of the accelerator pedal. The same speed range is available for both normal forward motion and also for backing up, one shift lever taking care of the two directions of travel.

Next biggest in the Sinclair haulage line—a 40-ton tractor and semi-trailer now in service in the Mark Twain pit.

The electric motors are designed to withstand a 100-per-cent overload for a period of about 5 minutes. Speed is limited to 32 m.p.h. Regenerative braking (General Electric) is available at speeds in excess of 13 m.p.h. with air brakes for service at all times. Rear tires are "Ground Grip" units of the same specifications as the trailer tires. Springs are designed to bend 1 in. under a load of 88,000 lb. Chassis weight is about 35,000 lb., making the total weight of this unit fully loaded around 230,000 lb.

At the end of February, 1939, the 80-ton unit was making about fourteen round trips per shift of seven hours. Average load per trip was close to 75 tons, or an average of 13 dipper loads of coal. Average daily mileage was around 85, and butane consumption was close to 20 gal. per hour. Dumping time is nearly the same with the big unit and it is able to holds its turn very well with the smaller ones. All in all, it is expected that, as compared to the 15-ton tractor-trailer units, the 80-ton job will net a saving of around $6,000 per year. With a total over-all length of 50 ft., wheel center to wheel center, the 80-tonner, by jackknifing, can turn in a space 50 ft. square.

Experiments with butane fuel started on May 3, 1938, at Tiger mine, using a Dart 350 tractor pulling a 40-ton Sinclair trailer as the guinea pig. Before that, however, an extensive investigation into the experience of other users, notably highway-transport companies, was made. On the basis of available information, the fuel seemed worthy of a trial, and consequently the proper tank and handling equipment was installed.

Butane burns cleanly, with the result that there is no dilution or sludging of the oil, no formation of carbon or even discoloration, and the engine runs cooler. Between May 3, 1938, and Jan. 8, 1939, the initial butane unit ran a total of 8,800 miles, during which time the engine was not touched. On Jan. 8, 1939, it was torn down for inspection and only minor repairs and adjustments were found necessary. No carbon or even discoloration was observed.

Table I—The Sinclair Haulage Picture in a Nutshell—Equipment, Distance and Output at Each Operation

Mine and Company	Tons Mine-Run to Hopper	Number Haulage Units	Equipment: Tractors	Equipment: Semi-Trailers	Round-Trip Haul in Miles: Max.	Round-Trip Haul in Miles: Min.
Sentry, Sentry Coal Mining Co..	3,500	5	Autocar..	15-T. Senford-Day....	3	½
Delta, Delta Coal Mining Co....	2,500	4	Autocar..	17-T. Sanford-Day....	3	1
		1	A.C.F....			
Mark Twain, Huntsville-Sinclair Mining Co.....	2,800	6	Dart.....	40-T. Sinclair.....	16	14
		1	A.C.F....	20-T. Austin-Western..		
		1	Mack.....	10-T. dump.....		
		1	Hug.....	8-T. dump.....		
Tiger, Hume-Sinclair Coal Mining Co.....	4,000	1	Dart.....	80-T. Sinclair.....	8	6
		1	Dart.....	25-T. Sanford-Day....		
		1	Dart.....	20-T. Sanford-Day....		
		3	Autocar..	20-T. Sanford-Day....		
		2	A.C.F....	20-T. Sanford-Day....		
		2	Autocar..	16-T. Austin-Western..		
		1	Mack.....	16-T. Austin-Western..		
Broken Arrow No. 4, Seneca Coal & Coke Co.....	1,600	1	A.C.F....	20-T. Sanford-Day....	4	2
		2	A.C.F....	15-T. Sanford-Day....		
		1	Mack.....	15-T. Sanford-Day....		
		2	Autocar..	10-T. Sanford-Day....		
		4	Ford.....	6-T. United I. W.....		
Broken Arrow No. 2, Seneca Coal & Coke Co.....	1,200	7	Ford.....	6-T. United I. W.....	2	1

NOTE: The 20-, 10- and 8-ton equipment at Mark Twain probably will be replaced this year with 40- or 80-ton equipment.

CHANGED PILLAR LAYOUT

+ Plus Pillar Cutting and Improved Haulage Spotlight Woodward's Mulga Mine

By J. H. EDWARDS
Associate Editor, Coal Age

• Saving an additional 35 per cent in coal recovery by changing method of mining from wide rooms and thin pillars to a panel-and-block system has been accomplished at Mulga mine, Woodward Iron Co., in Alabama. Undercutting machines, formerly remaining idle while pillars were robbed by pick-mining, are now constantly employed. Water is used on cutter bars, ventilation is arranged so that air moving back across pillar falls passes directly to return aircourse, although most of the methane is liberated when blocks are developed. Mulga mine output of 2,700 tons per day of two 7-hour shifts is hauled by company railroad to the Woodward byproduct ovens.

CHANGE to a panel-and-block system during the last two years has almost doubled recovery and was the means of introducing pillar-cutting as a standard practice in the Mulga (Ala.) mine of the Woodward Iron Co. In the same period the outmoded main haulage was improved by extensive grading, installation of heavier rail, and the purchase of two new locomotives of greater weight and higher speed.

This mine, situated in Jefferson County, 10 miles west and two miles north of Birmingham, is a shaft operation in the Pratt seam, which in general lies approximately level but has some severe local grades. Described from bottom to top, the seam, in the territory where the panel-and-block system is being worked, consists of: coal, 14 in.; medium to hard shaly slate, 12 in.; coal, 32 in.; bone, 2½ in., and coal, 9 in.—total thickness, 69½ in. The roof is a laminated shale containing sand and this type of material persists for about 20 ft. It is topped with a strong sandstone.

From the time of its opening in 1908 and until 1937 the mine was operated on a room-and-pillar system wherein the rooms were driven wide with track in the center and with the partings gobbed on each side. That system, together with leaving rather narrow pillars between rooms, did not permit effective robbing, hence the recovery was not over 60 per cent and in certain sections did not exceed 50 per cent. In the pillar work that was attempted from time to time the undercutting machines regularly used in rooms were left idle and pick-mining was substituted.

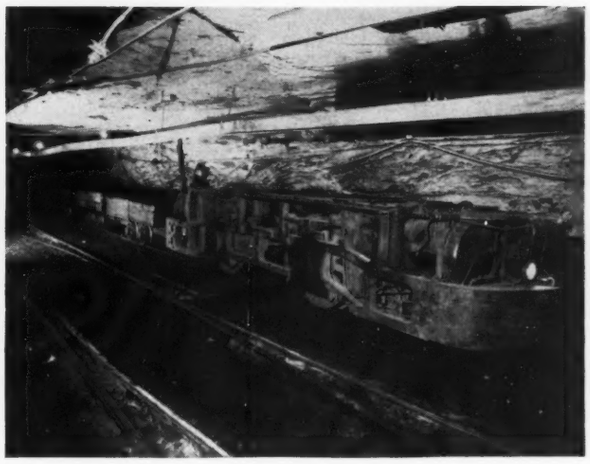
Recovery with the present system is calculated at 95 per cent exclusive of barrier pillars. The mine is gassy—approximately 750,000 cu.ft. of methane is liberated per day. Cutting equipment, formerly consisting of three types of shortwalls—Sullivan CE6, Jeffrey 28A and Goodman 112AA—has been augmented by the purchase of two new Jeffrey 35BB permissible shortwalls and one Jeffrey arewall. This one track-mounted machine, however, is used only on narrow work.

In the section of the mine where the systematic pillar extraction is

Undercutting the final stump of a pillar (Cut No. 10, Block *D*, Fig. 1). Arrows point to the rock fall at the line of fracture of the overlying roof strata.

Fourth undercut of the second cut-over (equivalent to *i*, Block D, Fig. 1) completed. Timbers tight against right rib will become part of next breaker row.

Another view of the equivalent of Cut i, Block *D*, Fig. 1. The timbers and also a double breaker row farther to the left will be pulled as soon as the cut-over is completed.



Main haulage at Mulga has been modernized with two new 18-ton locomotives with roller-bearing journals. These locomotives operate over new 60-lb. track graded to 2 per cent.

now under way, the room entries, each consisting of an 18-ft. aircourse and an 18-ft. "heading," with 32-ft. chain pillars between, are spaced to form panels 248 ft. deep. Referring to the drawing, Fig. 1, rooms 18 ft. wide are driven through from haulage heading to aircourse and 14-ft. crosscuts are driven between rooms to form blocks 52x57 ft. These blocks are nominally considered to be 55 ft. square and in the future developments blocks of that actual size may be the rule, but again the size may be varied either way to suit local conditions.

Tracks in haulways and rooms are placed at one side and the partings are gobbed along the rib on the opposite side. Only in mining the first two cuts of room necks and crosscuts is it necessary to load the rock. The illustrative purpose of Fig. 1 is to explain certain phases of the work and not to present a complete picture of the status of the work at any one time. The latter would require showing the mining in practically the same phase in each of the four blocks *A, B, C* and *D,* which would be repetitive.

Block *D* indicates a typical order of attack by cut-overs 18 ft. wide along the two sides next to the fracture line. The numerals of the block indicate progressive cuts by one crew and the small letters the cuts mined by the other crew. Whichever crew happens to start first or is ahead as the back corner is neared continues the cut-over to the end, and the other crew starts another series of cuts 18 ft. long.

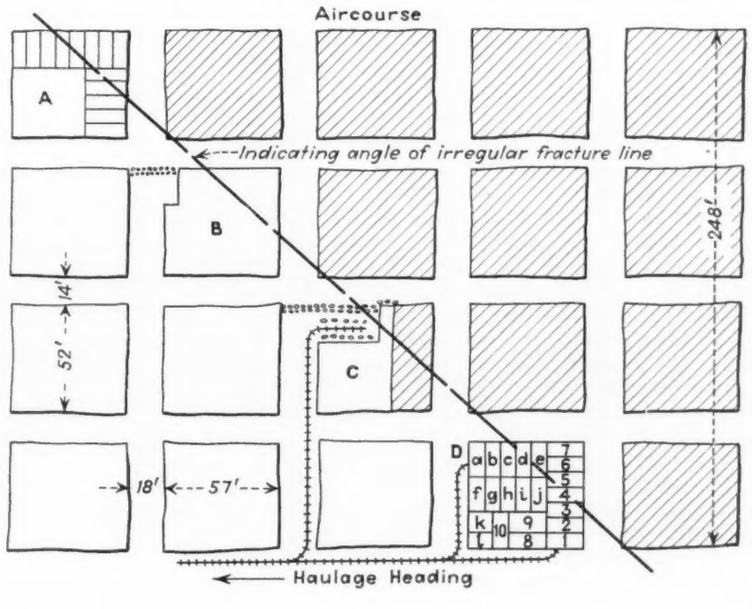
At block *B,* with one cut taken, a double breaker row of timbers is shown in regular position. As the cut-over is advanced (now refer to block *C*), the breaker row is extended and a single row of posts is placed tight against the rib. Rows of a breaker are 1 ft. apart and the posts are on 4-ft. centers. After a cut-over is completed the breaker row and other timber are pulled with a ratchet-and-pawl manual puller.

Timber recovery is about 60 per cent and the object is primarily to promote roof breaks. Excessive weight, and gob piled nearly to the roof in some places, prevent recovery of many timbers. The posts are re-used, but in many cases the cost of pulling exceeds the cost of new timbers delivered to the working place. The Southern or loblolly pine is used and its cost is comparatively low.

On both pillar and narrow work water is used on mining-machine cutter bars. Coal is shot with Duobel A permissible explosive. The mine is ventilated by an exhaust fan and the travel arranged so that air moving back across the pillar falls passes directly to the return aircourse. Not much gas occurs in the pillar mining. Most of it is liberated when the rooms and headings are driven to develop the panels and blocks.

The mine output is 2,700 tons per day of two 7-hour mining and hoisting shifts, one extending from 7 a.m. to 2:30 p.m. with 30 minutes out for lunch and the other from 5 p.m. to 12 midnight without time out. The shaft is 220 ft. deep and the coal is hoisted in the cars at the rate of three cars per minute on

Fig. 1—Four blocks nominally 55 ft. square are developed between room entries.



double-deck cages actuated by a double-drum steam hoist. Cars move off the cages to a rotary dump situated 35 ft. from the shaft. Mine loadings average 2 tons and the equipment consists of 500 wooden cars and 55 steel cars, all having Timken roller bearings. Track gage is 44 in.

Haulage distance from the panel-and-block workings to the shaft is four miles. The main haul was changed from 40- to 60-lb. rail and top or bottom removed where necessary to reduce the maximum grades against loads to 2 per cent. Ties are creosoted oak 4x6 in. x 6 ft. Long type No. 4/0 arc-weld bonds are used. Although a dispatcher has been employed at the mine for some years, his service to haulage has been augmented by block signals operated manually from roof-mounted switches. Installation of two Mines Equipment Co. electric switchmen at main junctions has further improved track facilities as regards both speed and safety.

Ten-ton plain-bearing locomotives formerly used were replaced by two new Westinghouse 18-ton locomotives having Timken journal bearings. Controls are contactor type with manual reverse and there is full control equipment in each cab. The system is the progressive series-parallel with five series points and four parallel points. Three methods of braking are provided: dynamic, air-operated and manual. Air-sanding and an air whistle are other refinements which add convenience and, to some extent, safety. Direct-current voltage is 275.

Mulga mine is on the Woodward Iron Co.'s own railroad and the tonnage goes to the byproduct ovens at the furnace plant at Woodward. The tipple is without coal-washing facilities and this fact plus the dirty seam has been responsible for continuing hand-loading. Some experimenting has been done, however, with scrapers and conveyors.

1,550-TON BIN

+ Built in Interval Between Two Seams Stores Fayette No. 4 Mine Output

THAT operation of coal-handling and preparation equipment more than one shift a day reduces investment cost per ton of output goes without saying. And with the substantial sums involved in installing modern mechanical-cleaning plants, the incentive for multiple-shifting becomes correspondingly greater. Consequently, when the Snow Hill Coal Corporation acquired additional reserves in an upper seam, operating officials immediately began a search for an economical method of bringing the output from this new acreage to the existing Talleydale preparation plant rather than build a new one. The method was found and now the Talleydale plant prepares coal from the Talleydale No. 3 mine, which it originally was built to serve, on one shift and coal from the overlying Fayette No. 4 mine, the new operation, on the succeeding shift.

Back of this bare statement of fact, however, is an unusual series of departures from usual mining practice. As an example, the new Fayette No. 4 mine has no opening to the surface at the present time and is reached only by openings driven up from the No. 3. Further, the Fayette No. 4 mine cars never leave the workings in that seam. Instead, they dump into a bin with a capacity of 1,550 tons, approximately the rated capacity of the new mine, built in the interval between the No. 3 and No. 4 seams. From this bin the No. 4 coal is hauled through the No. 3 workings in the No. 3 mine cars to the No. 3 shaft for hoisting and preparation on the second shift. For this purpose, a special haulage road has been laid out in the No. 3 mine.

• Storage bins holding 1,550 tons of mine-run are not common and when such a bin is built underground to hold the entire output of a mine it becomes real news. Thus, the Snow Hill Coal Corporation makes the headlines by incorporating such a storage unit in its plans for developing the new Fayette No. 4 mine. Excavated in the interval between the two seams, the bin substantially reduced the cost of the new operation —in the upper vein—and permits two-shift utilization of the preparation plant originally built to serve the Talleydale No. 3 mine. No. 4 coal is hauled through the No. 3 workings to the No. 3 hoisting shaft, and No. 4 mine is equipped with track-mounted loading machines, track-mounted cutting-and-shearing machines and 260-cu.ft. drop-bottom cars.

The present Talleydale shaft, as outlined in *Coal Age*, November, 1936, p. 481, is the third to be sunk in a space of some 300 ft. in this location—about ten miles north of Terre Haute. The first was used in mining the No. 4 coal and the same was true of the second, from which the No. 4 was worked to the south and east and also to the west and north until a thickening of a parting in that direction made operation difficult with the hand-picking methods prevailing at that time. The second shaft then was extended down to the underlying No. 3 seam. However, bands, partings and pyrites in the No. 3 again posed a difficult preparation problem for the day, and operations were suspended until the property was taken over in 1934 by Snow Hill, which foresaw the possibility of producing a substantial tonnage from the No. 3 by installing a mechanical-cleaning plant.

A new hoisting shaft was necessary if the proposed plan of com-

pletely mechanizing the No. 3 workings and using large cars was to be carried out. Sinking in the old location was the most logical in view of railroad connections, existing surface facilities which might be worked into the new operation, the possibility of utilizing the development already in the No. 3, etc. Consequently, the new shaft was put down through the old No. 4 workings to the Main East and West entry in the No. 3, in which the bottom was built. The old hoisting shaft was cleaned out for use as an airshaft and a new mechanical-preparation plant was built, all under Allen & Garcia Co. direction.

As the condition of the entries in the No. 4 workings, which were sealed off when the new shaft was sunk, practically precluded their use to reach virgin territory, it was tentatively planned when Snow Hill took over the new No. 4 acreage to make use of the old Bardyke shaft northeast of Talleydale, from which an entry extended westward to the new territory. It would have been necessary, however, to install new hoisting equipment at Bardyke and either build a new preparation plant or haul the coal by rail to Talleydale. Therefore, while Bardyke superficially was the logical way of reaching the No. 4, reequipping it for hoisting would have meant a substantial cost in addition to a possibly heavy outlay for cleaning up underground, on top of which would have been the cost of a new preparation plant or the long-time aggregate of rail charges for moving the coal to Talleydale.

Storage Bin the Answer

Neither of the above alternatives was the last word, in the opinion of the management. Finally, after consideration of a number of alternatives, including storage of the coal in the No. 4 mine cars and letting them down into the No. 3 on the second shift, the idea of the 1,550-ton bin was evolved by James Hyslop, manager of operations, and A. K. Hert, superintendent. Details of the installation were worked out by the Allen & Garcia Co., and it was favored by a happy combination of circumstances, one of which was an almost-made-to-order interval between the Nos. 3 and 4 seams. The net result was that the total cost of developing the No. 4 mine, including bin, auxiliary man-and-material slope and airshaft, all constructed in the interval between the two seams, was materially under the estimated cost of reequipping and reopening Bardyke and was less than one-third the cost which probably would have been incurred in opening by new shafts from the surface.

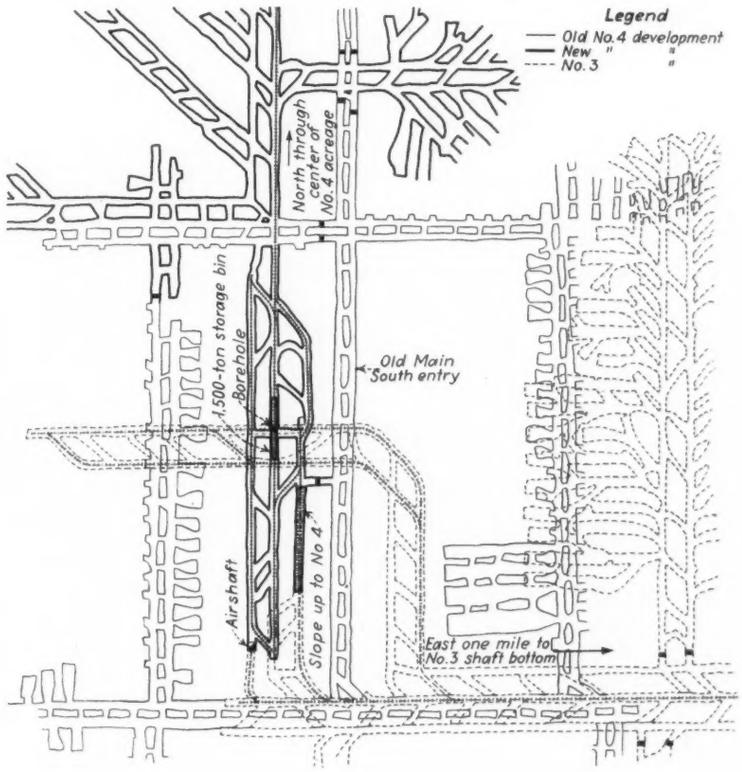
To recapitulate briefly, therefore, development of the new Fayette No. 4 mine was predicated on construction of a bin sufficiently large to hold approximately the contemplated daily production of 1,500 tons in the interval between the Nos. 3 and 4 seams. Like Talleydale No. 3, Fayette No. 4 was planned as a completely mechanized operation with its own equipment, including mine cars, adapted to No. 4 conditions. Coal is loaded on the first shift and dumped into the storage bin, from which it is hauled to the No. 3 bottom in No. 3 equipment on the second shift. Thus, No. 3 cars, locomotives and hoisting equipment are used for both the No. 3 and No. 4 coal, which is prepared and shipped as two separate products by using the same preparation plant and working it two shifts.

The coal acreage to be recovered by the new Fayette No. 4 mine lies to the west and north of the old No. 4 workings served by the old Talleydale shaft. Thickness of the main body of the No. 4 to be worked is 5 ft. to 5 ft. 2 in., exclusive of parting. Thickness of the cover is around 350 ft. Immediately over the coal is up to 12 to 18 ft. of slate, while the bottom consists of about 2 ft. of sandy shale. An excellent top is expected as the coal is opened up. The territory is in the form of a long narrow rectangle with the long axis running north and south. On the eastern edge, the seam includes a thin ($\frac{1}{4}$- to $\frac{3}{8}$-in.) "blue band," which thickens and changes to a white shale to the west. It is expected that mining will be extended to the west until the parting thickens to 12 in., although even thicker parting may be handled if it seems feasible. Aside from this parting, which occurs about 30 in. up from the bottom, the coal is classed as very clean.

The point where the bin is installed is about 5,000 ft. straight west of the Talleydale No. 3 shaft, which also is the present western edge of the No. 3 workings, as well as the approximate western edge of the old No. 4 development. In fact, the bin location was selected with the idea of going into the old No. 4 Main South entry and extending it north to split the new territory. So far, however, its condition has made reopening impossible and a new main is being driven parallel to it. The old opening is being investigated from time to time, however, and will be picked up if its condition improves.

As the bin is offset slightly to the

Fig. 1—The Fayette No. 4 storage bin was built at the south end of the acreage to be worked. Coal will move east from the bin to the Talleydale No. 3 shaft.



north of the Main West entry in the No. 3 mine, the actual haul to the shaft bottom is close to 5,500 ft. As indicated in Fig. 1, the track layout in the No. 3 seam is such that a trip can be pulled in past a car-haul-type retarder. When the trip is picked up by the retarder, the locomotive cuts off and uses crossovers to get on the front end for the run back to the No. 3 shaft. From the No. 3 bottom to the bin, trips will move over a 70-lb. main line graded as necessary for high-speed operation.

Actual construction of the bin was started on Aug. 1, 1938, at which time an opening in the No. 4 seam reached the site. Preliminary operations, however, included drilling a borehole from the surface down to the center of the bin location for bringing in concrete and also driving up a slope from the No. 3 seam. The interval at this point, as shown by a near-by test-hole log, was 61 ft. Starting on the No. 3 seam, the interval consisted of 12 ft. of gray slate, 18 ft. of hard sandstone, 1 ft. of No. 3A coal, 2 ft. of hard limestone, 3 ft. of sandy shale, 21 ft. of dark gray slate, 2 ft. of sandstone and, under the No. 4, 2 ft. of sandy shale.

Length of the slope, driven up from the No. 3, was approximately 120 ft. Excluding vertical curves at the top and bottom, the pitch is 40 per cent. Dimensions were 6x14 ft. in the clear, and it was advanced in lifts of approximately 6 ft. In the early part of the raising, the rock was manhandled to the car at the bottom, but a buggy and hoist were used in the final stages. On one side, a 4-ft. compartment fitted with stairs was reserved for a manway. This compartment also was the intake for the No. 4 workings until the auxiliary airshaft was constructed and consequently was separated from the main hoisting compartment by a sheet-iron partition, which now prevents men from sticking heads, arms or legs out in the hoisting section.

The slope has been laid with a 70-lb. track and timbered with 6x8 and 8x8 creosoted bars and legs, with the legs inclined 2 deg. uphill. A 100-hp. hoist was installed at the top of the slope for handling cars and other track-mounted equipment.

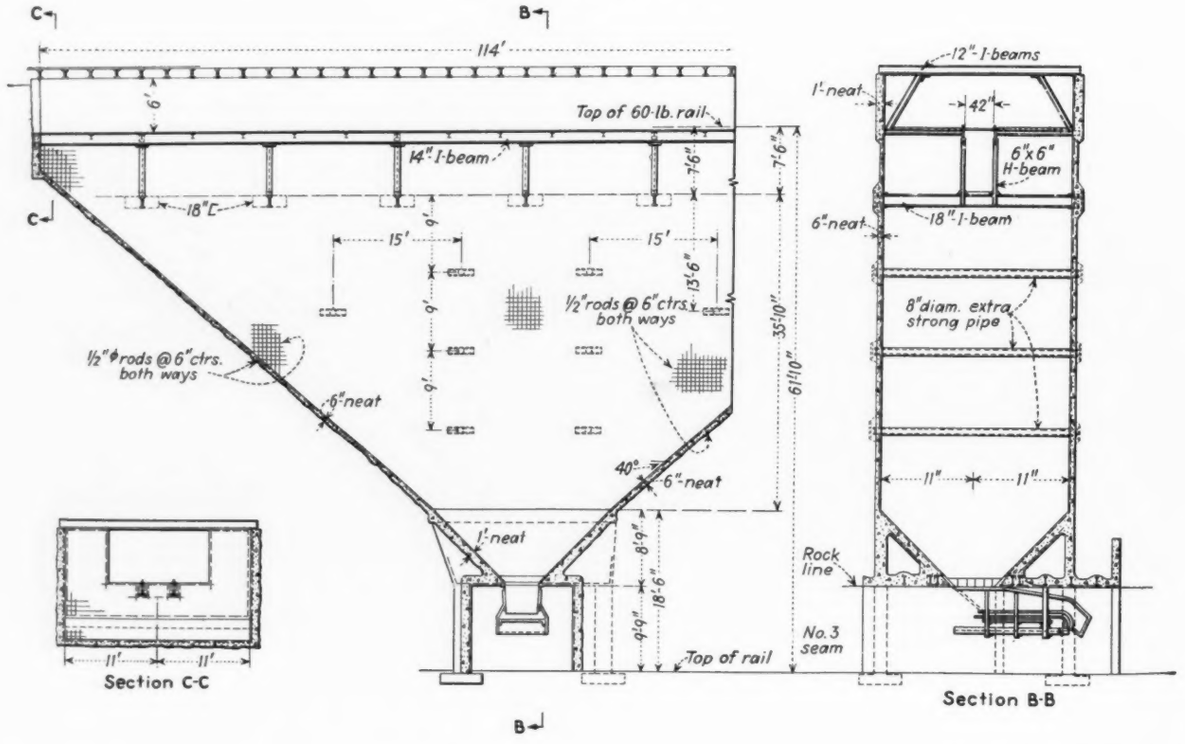
No Trouble in Coal Flow

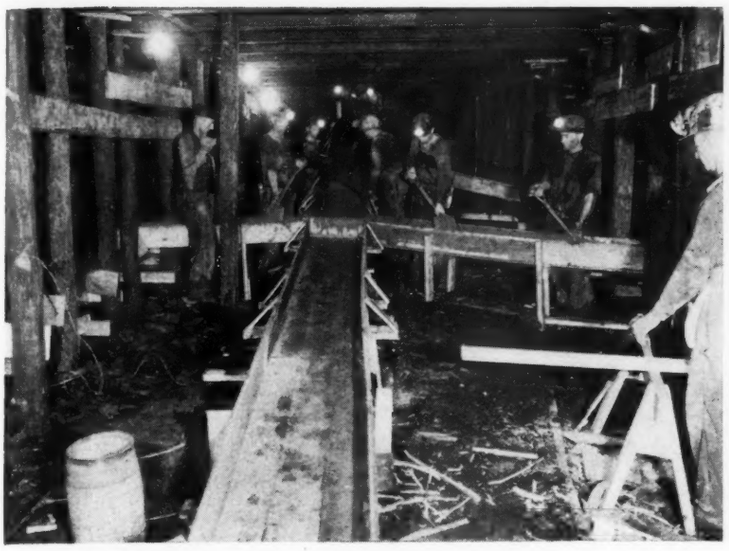
The bin is 114 ft. long and 22 ft. wide at the top, inside measurements. Total depth from the top of the rail is 52 ft. 1 in. Sloping of the ends, as indicated in Fig. 2, starts near the top, while the sides are straight down to within 8 ft. 9 in. of the bottom, whereupon they also begin to slope in at 40 deg. to the 46x60-in. opening in the bottom. With the 40-deg. slope, no trouble has been encountered from refusal of the coal to flow.

The roof over the bin is protected by 12-in. I-beams, which were brought in and placed on temporary legs to blueprint specifications as fast as the coal was loaded out over the bin site. By Aug. 12, 1938, this job had been completed, using a Goodman 260A loading machine, so pouring of the concrete walls along the coal ribs was started. These walls, carrying the roof beams, were made approximately 12 in. thick and, like all the other concrete work, were reinforced with ½-in. round rods on 6-in. centers both ways. Quick-setting cement was used and eight days was allowed for the concrete to set, the time being occupied with drilling the bottom, removing the forms and doing other necessary work.

In excavating the pit for the bin, holes 4 to 6 ft. deep on about 4-ft. centers were drilled and loaded as heavily as possible with 40-per-cent gelatin in order to break the material up as much as possible and make it easier for the loading machine to handle. Loading by machine was the rule until the pit reached a depth of about 12 to 14 ft., at which point the grade into the opening became too steep for tramming. Material was deposited in No. 3 pit cars, which were handled one at a time by an 8-ton cable-reel locomotive. Loaded pit cars were dropped down the slope and taken to the No. 3 shaft

Fig. 2—With a capacity of 1,550 tons, the storage bin is equipped with an apron feeder to discharge the coal into the No. 3 cars.





Concrete for the storage bin was dropped down through a borehole. This view shows the sluices used in distributing the concrete in building the walls along the coal ribs.

for hoisting and disposal of the rock. In all, a total of 808 cars of material (6 tons per car) were loaded in excavating the pit, of which 402 cars were taken out of the top by the loading machine, the remainder being loaded from a point in the No. 3 workings, as will be detailed later. While it is impossible to say exactly what the cost of the excavation would have been by other methods, there is no doubt that handling material with the loading machine, including coal, resulted in a substantial saving.

In preparing for excavation, the bottom in the No. 4 was sloped down from a point 75 ft. away to a depth of 5 ft. below rail level at the south end of the pit. The first lift of bottom material, about 4 ft. thick, then was loaded out, starting at the south end and extending the track as the loader moved forward. The next lift then was drilled and shot, the entrance track was relaid on a steeper grade, and the second batch of material was loaded out. A third lift was removed in a similar manner, making the pit depth 12 to 14 ft., at which point the loading machine was transferred for the reason noted above. The main supporting beams for the bin track then were placed and 12 ft. of concrete 6 in. thick and reinforced as previously stated was poured on both the sides and ends. A pneumatic pavement breaker was used in trimming up in preparation for concreting, air to operate this unit as well as a drill being supplied by a Cantrell air compressor mounted on a mine-made truck—one of two such units in service at the Snow Hill Plant. In fact, both units were used at times in excavating for the bin and in other necessary drilling and trimming work.

As indicated in Fig. 2, the rails over the bin rest on girders made of 14-in. I-beams 30 ft. long welded together. In fact, all steel work in the bin was welded, bolts being used only in erection. H-beams extend from these girders to the sides to hold the girders in position and thus maintain track gage. Braces running up from the H-beams to the roof beams tie the whole structure together and prevent weaving or other movement in a horizontal plane. The girders rest on vertical H-beams in turn supported on the main I-beams 7½ ft. below the top of the rails. This construction, shown in Fig. 2, was necessitated by the selection of drop-bottom cars for the No. 4 mine.

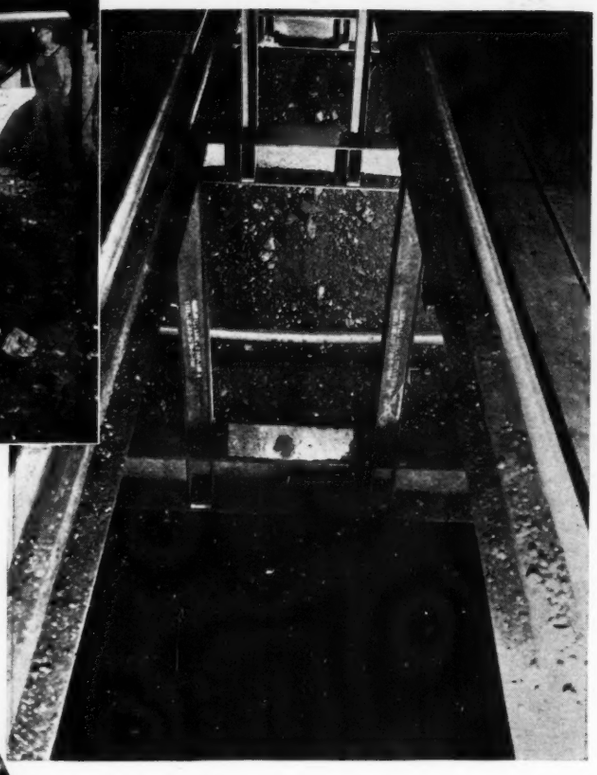
After pouring of the first 12 ft. of the sides and ends, eight days again was allowed for setting. In this interval, in addition to taking off forms cleaning up, etc., a round of 6-ft. holes was drilled in an 8-ft. square in the center of the pit and the broken material was thrown out. A second round then was put in and the material left in place, whereupon the next step was to go down into the No. 3 mine workings and start raising an 8-ft.-square hole to meet the one started from the top. In three days a hole from the bottom raise penetrated the earlier work.

Operations then were transferred back to the pit, the process there being to shoot out from the shaft the required distance, the material falling through the opening to the No. 3, where it was picked up by the loading machine. As the pit was sunk in this fashion, the concrete for the sides and ends was poured in 12-ft. sections, the final step being the pouring of the feeder inclosure in the No. 3 mine headings (Fig. 2). As pouring of the bin progressed, cross members of 8-in. extra-heavy pipe were installed as shown, but part of these since have been taken out as a result of their being bent by the weight of the coal.

A plain apron-type feeder with a maximum capacity of 10 tons per minute was installed at the bottom of the bin. Placed over and parallel

Showing how the pit looked after the first 12 to 14 ft. of excavation. Part of the I-beams for supporting the track are in place. At the top are the roof beams.

Loading in a room in Fayette No. 4. Height of the loading machine was cut down to correspond with coal height, and the rear conveyor, equipped with rubber-belt side boards, was lengthened to fit in with the big new cars used.



Looking down into the north end of the bin, showing it partly filled with coal. The I-beams and uprights support the track.

Left—Apron feeder used to discharge coal from the bin into mine cars in the Talleydale No. 3 workings. The trip retarder has not yet been installed.

Bottom Left—Making a shear in a heading face in Fayette No. 4 mine.

Below—Drop-bottom mine cars discharging into the completed bin.

Entrance at the south end of the pit used for the first 12 to 14 ft. of excavation. At this point, as can be seen, track grade became too steep to use the loading machine. Fred Bieler, general mine manager, and Sam Biggs, Fayette No. 4 mine manager, are standing in the pit entrance.

to the track, it loads the No. 3 cars as they move under in the direction of the bottom. The feeder is driven by a 5-hp. d.c. motor and a resistance is to be installed to permit varying its speed when desired. Also, a retarder of the chain type is to be placed to control lowering of the trips past the loading point. The feeder is started and stopped to load a car and wait for the next one to move under. Experience to date indicates an average loading time per 6-ton car of around 30 seconds. Trips will consist of 25 cars each and to clean out the bin in one shift fourteen to sixteen trips must be moved a one-way distance of 5,500 ft. to the bottom. When the parting thickens, however, more material must be handled for a shipped tonnage of 1,500, so it is planned to have a loading machine in operation in the No. 4 while the bin is being emptied, thus adding to the quantity available for hoisting on one shift.

With the bin built, a 10 × 10-ft.-in-the-clear airshaft was raised from the No. 3 to the No. 4 seam, the material being handled by the Goodman loading machine in this case also. Thus, the No. 4 workings will be ventilated for some time to come by the present No. 3 fan, although eventually it is expected that an auxiliary airshaft and exhaust fan will be installed. No timbers were used in the airshaft.

Reaching the location on Aug. 1, the bin and feeder were installed and first coal was put through them on Dec. 23, 1938. Vincent Engle was construction foreman, while Sam Biggs, Fayette No. 4 mine manager, was in general charge of the development of the operation under Fred Bieler, general mine manager for both the No. 4 and Talleydale No. 3, and Mr. Hert. In digging the pit and putting in the bin, the basic crew was eight to ten men, with extra labor for such tasks as providing transportation, electric power, ventilation, supplies, etc., by the regular mine force.

Operations in the Fayette No. 4 mine at present are based on using a Goodman 260A loading machine cut down in height and with the rear conveyor substantially lengthened to fit in with the large cars in use. As additional territory is opened and production increases, additional Goodman 360 loaders will be installed. Cutting and shearing is done with Goodman 1024 equipment with 9-ft. bars equipped with trial Cincinnati chains and Duplex bits. Dooley drills are used, along with an experimental stationary Airdox unit for breaking down the coal. Cars are changed behind the loading machines with General Electric 8- and 10-ton cable-reel locomotives, at present hauling directly to the bin. Panel and room tracks consist of 40-lb. rail on West Virginia steel ties with West Virginia steel-tie turnouts.

To pave the way for maximum production from the loading machines by reducing the time required for car changing, Fayette No. 4 has been equipped with A.C.F. steel drop-bottom cars with a water-level capacity of 260 cu.ft. Of the four-axle type, these cars are equipped with 18-in. wheels on 66-in. centers and are designed to operate over No. 2½ frogs, although no frogs of a smaller size than No. 3 will be used. Length over the bumpers is 17 ft. 3 in.; inside, 15 ft. 7¼ in. Inside width is 7 ft. 6⅛ in., and the height over the rail is 44 in. The rear end is cut down to accommodate the rear conveyor of the loader. In the light of experience to date, the management sees no reason why the cars could not have been made 2 ft. longer.

Four drop-bottom doors are used, along with link-and-pin couplers, and a spring buffer on one end. Wheels are fitted with Timken bearings. Welding was done wherever possible and the material thus fabricated was "Cor-ten" steel, thereby reducing the weight of each car no less than 3,000 lb.

Snow Hill in the persons of Sam Biggs, Fayette No. 4 mine manager (second from the left), and A. K. Hert, superintendent (right), greets two Goodman representatives, W. N. Wheeler (left) and T. J. Anderson (second from right).

Notes ... FROM ACROSS THE SEA

DUST studies still are being made by the Safety in Mines Research Board of Great Britain. A Tyndallometer has been under test, designed for estimating the concentration of dust in a cloud, not by meticulously arresting the dust on a screen or in a bottle and then laboriously counting the number of particles of the right fineness by the aid of a microscope but by measuring the light scattered by the dust. Within limits, the intensity of the scattered light is independent of the size of the particles. Tests were made in which the brightness of a Tyndall beam scattered by dust particles in suspension in the air was measured by a photronic cell.

Admixture of various rock dusts with quartz dust has been found to reduce the quantity of silica that normally would be dissolved from the quartz alone. Hence, if silica is poisonous and silicosis is silica poisoning, the presence of non-siliceous material with quartz will make the latter less harmful, not, as has been thought, by dilution of the dust but in some more active and positive manner.

It is interesting to note incidentally that J. J. Denny, W. D. Robson and D. A. Irwin, also S. R. Rabson, have presented papers, before the Institution of Mining and Metallurgy and the former three also before the Canadian Institute of Mining and Metallurgy and the Canadian Medical Association, on a similar effect of a small percentage of fine aluminum powder to reduce greatly the quantity of silica which will be dissolved from dusts in water in a given time.

Ultimately, when equilibrium is obtained, almost the same quantity of silica will have been dissolved regardless of the presence of the aluminum, as Dr. Rabson stresses, but emphasis is laid by the three associated authors on the time involved in arriving at any degree of saturation. With 0.036 per cent of extremely fine aluminum, the solubility of silica, apparently in 20 hours with continuous agitation, is reduced 93 per cent.

This slow action in part results from the fact that the aluminum causes the silica to gather into flocs in such a degree that with the presence of 0.9 per cent of the extremely fine aluminum, complete flocculation and neutralization of the charge is attained.

Another cause is the adsorption of dissolved silica on the aluminum powder, and the third and most important, the adsorption of aluminum on the particles of silica as a gelatinous hydrated alumina, which on drying forms boehmite ($Al_2O_3.H_2O$). However, Dr. Rabson believes that the action of aluminum is not permanent and that eventually its protective action is destroyed.

In common with E. J. King, H. V. A. Briscoe, A. G. R. Whitehouse and J. S. Haldane, Denny, Robson and Irwin believe that there are "antidotal rocks" which moderate and even forfend the action of silica. Men working in the crusher house of the mills of the Porcupine gold district of Ontario with a mill feed containing 35 per cent of free silica do not develop silicosis, nor do animals exposed to such dust, though much of it is found lodged in their lungs.

Mr. Denny and his associates believe that the antidotal action is due to the presence of aluminum as hydroxides resulting from the breaking down of silicates. Some antidotal rocks, they say, may contain large quantities of iron, the hydrated silicates of which may take silica out of solution and thus play a part in the antidotal mechanism. Thus, it may be said perhaps in comment, that shale dust with a moderate percentage of free silica may be used for rock-dusting coal mines without detriment to health.

The quantity of silica excreted in human urine, declares the S.M.R.B., has proved not to be a reliable aid in diagnosing silicosis; in fact, two of the highest figures for such excretion were found in non-silicotic persons.

BY forming a coal-dust cloud 50 ft. long in a 225-ft. length of the 4-ft. gallery at Buxton, using for that purpose bags of dust suspended at equal intervals along the gallery and exploding a detonator in each bag, it was found by the S.M.R.B. that 0.2 oz. of Silkstone coal dust per cubic foot of cross-section (85 per cent of which dust will pass a 200-mesh I.M.M. sieve) will suffice to maintain and extend an explosion. The explosion traveled 180 ft. and shattered the wood disk closing the end of the gallery.

Can the tiresome counting of dust particles be avoided? Mixed with other dusts, quartz dust will dissolve less readily in water. Such "antidotal rocks" often are found in company with free silica. The "chemical mechanism" by which free aluminum acts has been described by three Canadians. Aluminous hydroxides may act on free silica like pure aluminum. Perhaps, the lung hazard of siliceous shale dust as compared with non-siliceous dusts has been overstressed.

Given air containing only 0.2 oz. of coal dust per cubic foot, an explosion once on its way will continue to travel. Dried gypsum dust will cake more rapidly than undried. How to keep clay plaster on walls damp, uncracked and tight. Can a plastic gunite be devised? How to plan dust barriers. Bomb-like effects of confined methane. Search for an explosive that will not ignite firedamp.

Of two samples of gypsum dust, one a pulverized raw dust and the other the same partially dehydrated in a kiln, the raw pulverized gypsum resisted exposure well but the other absorbed water and caked completely, showing it was not suited to mine use.

TO SEAL mined areas some British collieries use "waxwalls" which are clay facings 3 in. to 2 ft. thick distributed along the ribs of the roadway, gob sides or stoppings, but the clay soon dries and cracks so that air leaks through them, and men have to be employed to wet these walls, causing so much expense that the practice often has to be abandoned. Studies have been made into mixtures of clay and rock dust applied as a paste made from fresh or salt water.

These pastes have been applied in layers on coal and brickwork and those having 15 per cent of salt to 85 per cent of clay gave the most satisfactory results under conditions of test in which the dry-bulb temperature was about 75 deg. F. and the humidity about 80 per cent. But, at other mines, with higher temperatures and lower humidities, this proportion did not give such good results. However, mixtures of calcium chloride and rock dust have been found suited to these conditions.

Tests will be made of the leakage through experimental slabs after various time intervals. An attempt will be made to apply mixtures of this type with the cement gun, where, because of moving ground, cement gunite has not been found entirely satisfactory. Perhaps, something may be found more elastic than cement gunite.

Studies made into the aging of explosives revealed that sheathed explosives deteriorate less than unsheathed. Strange to say, contrary to usual experience, an ammonium nitrate trinitrotoluene explosive aged less than explosives containing 16 to 25 per cent of nitroglycerin.

WHETHER to use shale or limestone dust has been argued long and earnestly. Reporting the International testing stations conference in Belgium, the Safety in Mines Research Board of Great Britain declares that Herr Wilke, of Dortmund-Derne, Germany, had found in a gallery 656 ft. long and 27 sq.ft. cross-section that limestone dust was more effective than shale dust. No matter what dust was used in an explosion barrier, the quantities of dust needed were much the same.

In a gallery 82 ft. long, Herr Hanel, of Freiberg, Germany, had found that powdered rock salt was superior to shale and marble dusts, which themselves were nearly of equal effect. Six incombustible dusts were tested and the coal used was a Saxony product. Gallery tests and tests with the Godbert-Greenwald apparatus, declared Herr Glatz, of Czechoslovakia, gave almost identical results in tests of the flammabilities of five seams.

Rock-dust barriers, according to Herr Schultze Rhonhof, of Gelsenkirchen, Germany, must have every unit free from possible obstructions to its operation, must collapse completely when subjected to the shock wave preceding the flame, must be loaded with no more than 672 lb. of dust or less in place where the shock wave is likely to be weak, and should extend across the whole width of a roadway.

Neither a swinging suspension nor support by rollers is recommended. In some experiments units spaced at intervals of 30 ft. stopped explosions that could not be stopped by the same number of units spaced at intervals of 3 to 6 ft., presumably because, to be effective, the incombustible dust screen has to be of sufficient length or the flame will not be extinguished.

Strong explosions, asserted Herr Cybulski, are easier to stop than weak ones, but barriers usually can stop (1) very violent explosions and (2) strong explosions in which firedamp takes part only near their point of origin. He advocated two units 6 ft. apart, 90 ft. from the coal face, a second group 60 ft. further, a third group 30 ft. still further outby.

When M. Coppens, of Belgium, explained that methane is absorbed on the surfaces of the extremely fine particles of amorphous matter (micellae) of which a mass of coal is composed, M. Fripiat, of the same country, described an unfinished series of experiments to determine the conditions under which coal saturated with methane will burst into fragments when the external pressure is suddenly released.

AN EXPLOSION will ignite a mixture of methane and air only if (1) the products of detonation of the explosive mingled with the mixture of methane and air will form a flammable mixture and if (2) the energy in the products of detonation is sufficient to heat to its ignition temperature the mixture of the products of the combustion of the explosive with methane and air, said M. Audibert, of France. He believed that explosives could be made that would frustrate this, and indeed he had found them, but they were too weak to be of practical utility; so the research continues. Dr. Payman said that whenever an explosive is fired in a mixture of methane and air and whenever its products of complete detonation gain access to such a mixture, ignition always occurs even if only part of the surrounding medium is ignited.

R. Dawson Hall

On the ENGINEER'S BOOK SHELF

Requests for U. S. Bureau of Mines publications should be sent to Superintendent of Documents, Government Printing Office, Washington, D. C., accompanied by cash or money order; stamps and personal checks not accepted. Where no price is appended in the notice of a publication of the U. S. Bureau of Mines, application should be directed to that Bureau. Orders for other books and pamphlets reviewed in this department should be addressed to the individual publishers, as shown, whose name and address in each case are in the review notice.

Regulations and Orders Relating to Safety and Health, 1939 Edition, British Library of Information, New York. 199 pp., 6x9⅝ in. Price, 45c.

This publication of the British Mines Department gives the general regulations and orders promulgated under the authority vested in that department under the Coal Mines Act of 1911. Reading the references to the use of candles, one wonders how the British can be so lax in that direction while so severe in others. But the record for safety should still effectually any American criticism, and, indeed, the laxities are few.

Coal Mining in Europe, by G. S. Rice and Irving Hartmann, U. S. Bureau of Mines. Bulletin 414; 369 pp. Price, 50c.

For years the American public has awaited a summary of European coal fields, operations and methods, and it is indeed fortunate that the work of preparing such a book has fallen to the competent hand of Dr. Rice, who has made, through many years, several official trips to Europe. Information thus gained has been supplemented by his own and Dr. Hartmann's correspondence and research. In a degree the book is written interpretatively in such manner as to compare American with European conditions and practice. It should furnish many helpful suggestions to the engineer and also correct some misapprehensions.

Arc-Welding in Design, Manufacture and Construction. The James F. Lincoln Arc-Welding Foundation, Cleveland, Ohio. 1408 pp., 5⅝x9 in.; leather. Price, $1.50 in U.S.A.; $2 elsewhere.

A remarkably comprehensive record of arc-welding practice in which 115 authors collaborate. It deals not with arc welding *per se* but with applications of welding and how made. Sections are devoted to repairs and construction of automotive equipment, aircraft, railroad equipment, watercraft, structures, furniture and fixtures, containers, machinery, jigs and fixtures. One section relates to the use of arc-welding in general repair and construction shops. Though mining is not so much as indexed in this book, our industry has such a reach of interest that for almost every section some applications can be made of the types of operation therein described.

Annual Report of Research and Technologic Work on Coal, Fiscal Year 1938, by A. C. Fieldner, U. S. Bureau of Mines. I. C. 7052, 44 pp.; mimeograph.

This circular describes briefly the work of the Bureau of Mines in research and technology in the past year, notably in the origin of coal and its plasticity when heated, strength of coal in the mine, movement of the roof during mining, fires in anthracite mines, preparation, slag formation and combustion, carbonization and hydrogenation.

Reducing "Nipping" Hazards When Tramming Coal-Mining Machinery, by E. J. Gleim, U. S. Bureau of Mines. I.C. 7056, 3 pp.; mimeograph.

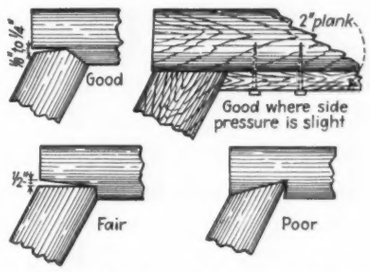
Nips are not only likely to cause electrocutions or shock but may injure the eyesight by the arcs thus formed. They pit and roughen the trolley wire, thus decreasing the efficiency with which current is collected by locomotive trolley wheels and shoes and at the same time shorten the useful life of these devices by increased wear.

Holding the commercial fused nip at arm's length is tiring, and therefore unfused nips too frequently are substituted. But without a fuse in the nip, a short circuit in the trailing cable may cause the destruction of the latter by fire, and possibly may ignite coal. An overfused tap may be shattered when the fuse blows.

When a machine is allowed to coast with the nip out of contact with the trolley wire, the motor becomes a generator and, if the operative has not shut off his controller, the nip will be alive and contact with it will give a severe shock, even perhaps electrocuting the operative. Some concerns have provided trolley wheel and harp for tramming machines, and some applications of this type have been approved by the Bureau.

Some Suggestions of Safety in Timbering Anthracite Mines, by R. D. Currie, U. S. Bureau of Mines. Miners' Circular 38, 21 pp.

In the main, questions and answers on methods used for timbering anthracite mines form the substance of this book. It contains probably nothing new nor does



Timber hitches favored by R. D. Currie for use in anthracite mines.

it claim any originality, but it will prove useful for miners everywhere. Illustration shows how three-piece sets should be framed.

Carbonizing Properties of West Virginia Coals and Blends of Coal From the Alma, Cedar Grove, Dorothy, Powellton A, Eagle, Pocahontas and Beckley Beds, by A. C. Fieldner and six others. U. S. Bureau of Mines, Bulletin 411; 162 pp. Price, 30c.

All the coals included in this paper but the Beckley are of high-volatile A rank, of which the coking power is low, but this can be improved greatly by suitable blending with a low-volatile coal. However, the mixture richest in low-volatile coal does not always produce the best coke. Effect of blending cannot be forecast. Tests are needed to obtain best results.

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OPERATING IDEAS

From

Production, Electrical and Mechanical Men

Wider Headings Can Mean Dollars in the Purse

Wider headings have been a major factor in the operating system of his company, writes E. A. Smith, chief engineer, Central Elkhorn Coal Co., Estill, Ky. Usually, where wider headings can be employed, depending upon top conditions, the measurements are increased enough to provide coal for two man-shifts per cut. In other words, it is a provision of the mining system that each working place should produce 20 tons, or 10 tons per man-shift.

"This plan of using two men per working place could only mean double progress in development. It could mean, too, better-loaded cars for each trip, for if one man can load a car 'quick,' two can load it 'double-quick,' to say nothing of better preparation of the coal at the face.

"Some even greater advantages result from such items as production of larger sizes of coal because of the lesser number of corner shots per ton. It is well known that corner shots are detrimental to the production of block or large-sized coal because they tend to shatter otherwise normally blocky coal to fines or other generally smaller sizes. Wider places also provide more room for gob, which otherwise would have to be taken outside, tying up equipment needed for moving coal, using unnecessary power, and taking up room in the refuse-disposal site.

"Wider places provide more room for track and facilitate the maintenance of clearances. Also, they produce more tons per track unit, wire unit, etc., and afford more room for top expansion. The writer has noticed that certain types of top will shear at the ribs and arch in narrow headings, whereas no trouble is encountered where places are driven wide, thus providing a wide area for expansion. More room for air can be an important advantage in widening openings carrying the ventilating current. Inherent concentration is another big item to us, meaning lower costs for ventilation, maintenance, timbering, dewatering, track, wiring, bonding, road cleaning, handling fallen top, haulage, piping, yardage and supervision.

"Since we have mined thousands of tons of coal from wide headings and plan to recover thousands more from such places, and since we have benefited from the inherent thousands of tons of increase in block and other larger sizes and have left, and plan to leave, thousands of tons of gob inside, it is well to assume that 'wider headings can mean dollars earned.'"

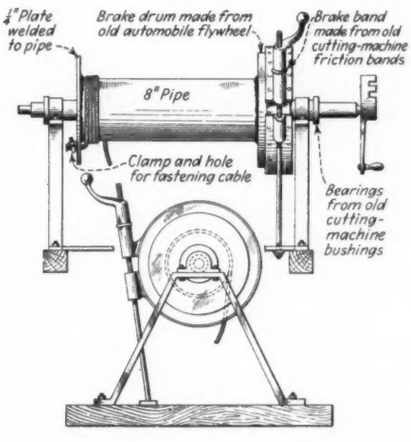
Trip Retarder for Mine Use Made From Used Parts

With coal brought out from the working places on a mother belt, trouble originally was experienced in dropping trips of empty cars downhill to the loading point, writes John A. Simons, mine foreman, Dawson Collieries, Inc., Dawson Springs, Ky., in describing the construction of a mine-made retarder. "As we used a spillboard and as the belt was not stopped throughout the shift, except in case of trouble, it was necessary to push trips of empties into a tail track and drop them down a steep grade to couple them onto the trip going through the loading station, thus keeping a supply of empties under the belt at all times while the loads were cut off and taken to the bottom.

"Controlling the empties by sprags was not successful due to the fact that the cars were equipped with ball bearings and therefore were hard to control, so we made a retarder which works very well. The retarder drum is a piece of 8-in. pipe. The head on one end was made by cutting out a piece of ¼-in. plate to fit and arc-welding it on. For the brake drum we cut the inside teeth out of an old Buick flywheel and slipped the pipe into it, also welding it in place. For the shaft we used an old piece of cold-rolled steel and ground a shoulder on each end so that a crank could be slipped on and off for winding up the ½-in. rope. Bearings were made from old machine bushings held in place in the frame by ½-in. iron straps. The brake itself was fabricated from a couple of old cutting-machine brake bands, with a brake bolt anchored through a strap of ⅝x3-in. iron mounted on the base timbers.

"As the locomotive pushes the empties through a spring turnout, the brakeman hooks the cable on the front car and sets the brake. After the locomotive clears the turnout, the brakeman drops the cars down the grade and couples them onto those being loaded. The car trimmer then unhooks the rope and the brakeman winds it up with the crank and sets the brake for the next trip. This retarder can be mounted and braced so that it can be dragged or hauled from place to place. Furthermore, it can be used in many different ways where trips of cars must be lowered."

Showing how retarder is built, using old parts.


¼" Plate welded to pipe
Brake drum made from old automobile flywheel
Brake band made from old cutting-machine friction bands
8" Pipe
Clamp and hole for fastening cable
Bearings from old cutting-machine bushings

Drilling Horizontal Holes Aided by Arc-Welding

Of considerable importance in the application of arc-welding to mine drainage is its use in equipment for drilling horizontal or nearly horizontal holes through barrier pillars separating one property or territory from another, asserts Paul F. Erch, mechanical draftsman, Glen Alden Coal Co., Scranton, Pa., in a paper receiving honorable mention in the $200,000 Award Program sponsored by the James F. Lincoln Arc Welding Foundation, Cleveland, Ohio (*Coal Age*, October, 1938, p. 90). Such drilling is done to tap a body of water, which may be under considerable pressure—perhaps as much as 100 to 200 lb. per square inch. "Obviously," said Mr. Erch, "such tapping has possiblities of plenty of trouble and very little of it had been done until the method shown in the accompanying figure was devised.

"The plan is as follows: Assume that a

6-in. hole is wanted in a barrier 100 ft. thick. A preliminary 10-in. hole is driven with a rotary bit having hard points, or teeth, made up by arc-welding (*Coal Age*, May, 1939, p. 62). This 10-in. hole probably would be driven about 20 to 40 ft., depending on the stability of the barrier-pillar coal. Into this 10-in. hole a bronze lining pipe, made up with collars in 4-ft. sections and screwed together, is pushed. Cast-on runner ribs on the bottom side serve to center it properly, the inner end of this bronze pipe having been filled previously with a concrete plug formed around a 1½-in. steel grouting pipe and against an arc-welded steel-plate and sleeve combination. The forming plate having been removed, steel 1½-in. pipe is connected and extended back as the bronze pipe is built up. Also a small copper vent pipe, as shown, comes back to a garden hose and this hose is extended back through the bronze liner pipe. When all is in place a portland cement grouting without sand is pumped through the 1½-in. pipe, filling up the space at the end of and all around the bronze pipe until it appears at the face of the pillar. Air at the back end of the hole escapes through the small copper pipe and hose. As soon as any cement runs from this hose it is known that the back end of the hole is filled. When the cement has had time to set the hose is pulled out and the 1½-in. grouting pipe is unscrewed at the left-hand thread of the piece in the concrete plug.

"This leaves the bronze pipe thoroughly grouted into the hole and with no metal except the small copper vent pipe in the way of drilling on through the barrier with a 6-in. drill similar to the 10-in. drill used in the preliminary hole. The outer end of the bronze pipe has a flange and against this is now bolted a heavy bronze plug valve of a type having a round 6¼-in.-diameter hole through the plug, and following this a suitable length of 6¼-in. cored cast-iron pipe with a drain branch on the under side and a flange with stuffing box on the outer end. This pipe serves as a vestibule, or retreat pipe, for the cutter bit and the core barrel to which it is attached. The drill stem passes through the stuffing box.

"The drill now is advanced through the open plug valve against the concrete plug and on into the barrier coal. When the core barrel is filled the drill is withdrawn, the plug valve closed if necessary, the drain valve opened and then the stuffing-box flange removed. The barrel then is taken out, emptied and the procedure reversed. This process is continuous through the pillar, the workmen being perfectly safe even when they break through into the body of water. In this procedure, aside from the large saving in cost of the arc-welded cutting bits, as against diamond-studded bits, there is the further possible saving of a large expense which would result from the loss of any of the diamonds, as well as the costly process of trying to recover them."

On Hand

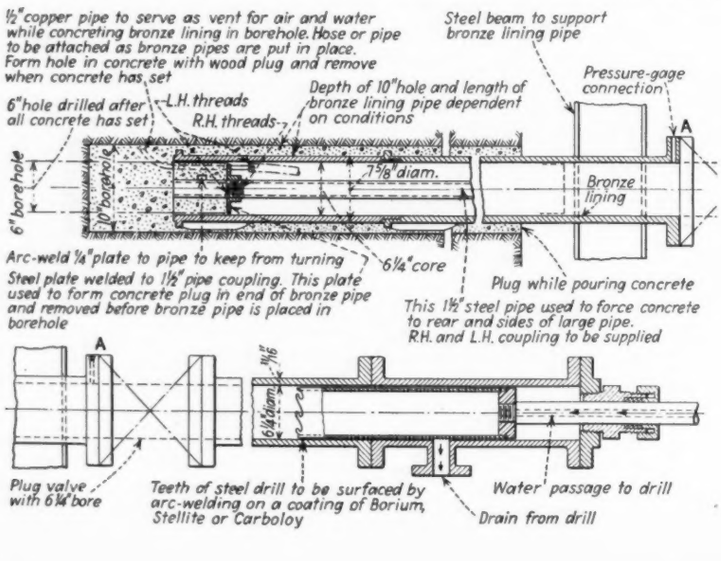
The term "file" refers to a number of activities and subjects, including repositories for material or information to be preserved for future reference. Thus, a man may carry a file of information in his head or may preserve notes in a drawer so that they will be on hand when he wants them, but in each case the object is the same—creation of a reservoir of information on which he can draw in time of need. Items in these pages are designed for inclusion in the files of operating, electrical, mechanical and safety men around the mines, who in turn originate the information here presented. So if you have a cost-cutting, efficiency-promoting or time-saving idea, send it in, together with a sketch or photograph if either will help to make it clearer. Acceptable ideas are paid for at the rate of $5 or more each.

Straightening Shafts and Rods By Hammering Methods

A job likely to be a little difficult for an inexperienced man is the straightening of shafts, axles and rods by the use of the hammer, declares John E. Hyler, Peoria, Ill. In many cases, he states, it is wise to use a soft hammer that will not mar the work, while in others hammer marks are of little consequence. In testing the work for straightness, it is well to have two straight-edges arranged on a bench top or other level place and close enough together to support the ends of the part while it is rolled along them. Any wobble indicates that the piece still is crooked, and the direction of bow is determined by how it comes to rest. In other words, marking the underside when the part comes to rest shows where to use the hammer. In emergency cases, where bars or rods are quite long, the railroad tracks may be used as a rough testing device.

The principle behind the straightening process is to provide a two-point support in which the piece can rest with the bowed side up. It then is struck with the hammer and tried on the straight-edges, repeating the process as often as necessary. V-blocks often are used for supports and may be mounted on a flat plate or a rigid bench top. Occasionally, short parts that cannot be supported very well on V-blocks are adaptable to straightening with a hammer. If the work is not too heavy to endanger a large vise, the work may be placed across the jaws after they are adjusted to suit the length. For very small parts, a monkey wrench lying on its side may be pressed into service.

Equipment used in drilling a horizontal water borehole through a barrier pillar.


½" copper pipe to serve as vent for air and water while concreting bronze lining in borehole. Hose or pipe to be attached as bronze pipes are put in place. Form hole in concrete with wood plug and remove when concrete has set
Steel beam to support bronze lining pipe
Pressure-gage connection
6" hole drilled after all concrete has set
L.H. threads
R.H. threads
Depth of 10" hole and length of bronze lining pipe dependent on conditions
A
6" borehole
10" borehole
7⅛" diam.
Bronze lining
Arc-weld ¼" plate to pipe to keep from turning
Steel plate welded to 1½" pipe coupling. This plate used to form concrete plug in end of bronze pipe and removed before bronze pipe is placed in borehole
6¼" core
Plug while pouring concrete
This 1½" steel pipe used to force concrete to rear and sides of large pipe. R.H. and L.H. coupling to be supplied
A
6¼" diam.
Plug valve with 6¼" bore
Teeth of steel drill to be surfaced by arc-welding on a coating of Borium, Stellite or Carboloy
Water passage to drill
Drain from drill

Bee-Line Lead-Sheath Cable Is Substation Entrance

Lead-covered cables extending diagonally and in a direct line from fused cutouts on the pole to the incoming panel is the simple and low-cost construction used on the Second-Right outside substation at Powellton No. 3 mine of the Koppers Coal Co., Elkridge, W. Va. Admittedly the job does not afford the finished appearance of conduit construction with vertical and horizontal runs and 90-deg. angles, but the cost is only a fraction of conduit installation. Since the substation is in a remote location near a crop opening on the mountainside, there would be little justification for spending money for appearance only.

The substation contains one 200-kw. 275-volt synchronous converter. It is fed from a 4,000-volt power line and the converter transformers are outside the building. As shown in the illustration, the lead-covered cable leading into the building and the one leading out to the transformer primaries are suspended on steel messenger. Potheads are not used but instead the ends where the lead sheaths are terminated are turned down to shed water. In approved fashion, the cables are bent to form drip loops where they go through bushings in the steel wall of the building. These lead-sheathed cables are No. 4 three-conductor units insulated for 7,500 volts.

The six low-voltage single-conductor

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DURING the course of its long life, an Exide-Ironclad Battery used in a mine locomotive may easily haul enough coal to fill a 45-mile-long train. In numerous instances the reports of operators using Exide-Ironclads show that these batteries far outlive their guarantee.

The *kind* of service a battery gives is just as important. Here, especially, you will notice the advantages of Exide-Ironclads. Their high power ability, sustained voltage for consistently good haulage speeds, and their extreme dependability, all join together to step up production and cut down costs. Write for free booklet, "The Storage Battery Locomotive for Underground Haulage."

THE ELECTRIC STORAGE BATTERY COMPANY, Philadelphia
The World's Largest Manufacturers of Storage Batteries for Every Purpose
Exide Batteries of Canada, Limited, Toronto

No frills to these 4-000-volt cable entrances.

cables leading from the transformer secondaries to the converter starting switch inside the building are taken in by another direct and simple means. These cables are converged by natural curves to one large concrete bushing at the center and just above floor level and are sealed into the bushing with compound.

Portable Power Bank Mounted on Sled

The portable power bank shown in the accompanying illustration has been built by Lyman Ellrick, chief electrician, Hickory Grove Coal Mining Corporation, Sullivan, Ind., for use anywhere around the property. The sled is made of I-beams and angles and carries three 15-kva. transformers (2,300 volts, 4,000Y, 460-230 volts). At the top of the rack are three fused cutouts and lightning arresters, as well as strain insulators for easy connecting to the drop from the pole. The unit, says Mr. Ellrick, is very easy to move by truck or tractor.

This power bank is portable for use where needed.

Proper Installation, Use and Maintenance Increase Conveyor-Belt Life

KEEPING rubber conveyor belts in good condition will substantially prolong their life, declares M. Berman, technical superintendent, Hewitt Rubber Corporation, Buffalo, N. Y., in offering a number of suggestions on their use and maintenance. "Ordinarily, the usual wear and tear make no great inroads on the life of rubber belts, but cuts and gouges that expose the fabric if not properly cared for may easily lead to damage that will mean permanent injury or costly repairs. Repairs should be made as soon as any cuts and gouges that expose the fabric appear. This matter of repairs is all the more important if the material being handled is wet, abrasive or corrosive. Successful minor repairs can be made from the materials that anyone can obtain at a tire shop or hardware store if the following directions are used as a guide:

"Take a sharp, wetted knife and bevel the edges of the cover around the injury. Start far enough back from the injury to make certain that all loose rubber is removed. If the fabric is wet, allow sufficient time for it to dry. Roughen the injury with emery cloth or with the roughing tool provided with tire-tube repair sets. Use a stiff brush or cloth and clean the injury with gasoline. Apply a heavy coat of rubber cement over the fabric and the beveled edges of the cover. When it is no longer tacky, apply a second coat and allow this to dry also. Cut a piece of the tire-tube repair gum the proper size, strip off the Holland liner and apply against the area with the tacky side down. By the use of a piece of pipe or the can used to package the tube-repair materials firmly roll or pound the gum into place. Allow a few minutes for the patch to set and then hold the wetted knife flat and trim off all projecting edges. The patch should be smooth and preferably slightly recessed below the surface of the cover.

"If the carcass of the belt has been ripped or torn, the belt can be held together with staple-type fasteners. Injuries along edges are difficult to repair and any loose rubber or fabric should be trimmed away at once to prevent further stripping. If the belt has been badly injured, it is necessary to splice in a new section or make a vulcanized repair. Many large operators of conveyor belts have experienced substantial savings on replacements by owning a portable electric vulcanizer and training a crew on belt maintenance. With this equipment, repairs may be made practically permanent. The electric repair vulcanizers are reasonably low in cost and light in weight.

"On a conveyor handling wet or sticky material, the life of the belt will be prolonged by the use of an automatic brush, revolving on the belt just where it leaves the head pulley and before the carrying side comes in contact with a snub pulley or a return idler. The peripheral speed of the brush is much higher than the belt speed and its motion is in the opposite direction so that material brushed from the belt is thrown forward into a chute. The rubber brush is preferred. The bristle brush wears away much more rapidly than rubber and also has a tendency to hold sharp particles of material between the bristles.

"Some suggestions on splicing conveyor belts may be in order. Practically all conveyor belts may be successfully joined by means of metal fasteners and there are several good conveyor-belt fasteners on the market. For light- and medium-duty conveyors the staple type of fastener gives good results. It is easily applied and requires no special tools. For heavy-duty, high-tension conveyors the double-plate type of fastener should be used. The plates serve to compress the belt and the anchorage is thereby materially increased. This type of fastener should be used wherever there is a severe reverse bend due to tandem or tripper pulleys. The shallow plates become embedded in the covers and the center of pull is along the neutral axis of the belt.

"Care should be taken to cut the ends of the belt square. If boltholes are required, these should be carefully punched so that the fasteners will pull uniformly over the width and the various plies. Uneven strains, due to improperly applied fasteners, may result in ply separation or belt injury. The fasteners should be inspected regularly and renewed at the first indication of weakness.

"Some operators of conveyors have economized by making their belts endless with portable electric vulcanizers. In certain high-lift installations, where the tensions are extremely high, an endless belt is almost essential. The vulcanized splices are stronger and have the advantage of giving smoother traction when traveling over pulleys. Before making a long-center conveyor belt endless in the field, it usually is good practice first to operate the belt temporarily with fasteners. This reduces the likelihood of the belt stretching beyond the limits of the take-up and necessitating a new splice.

"Care should be taken when a belt is first installed to see that it is trained correctly. It may be seriously damaged if it does not run true and in the center of the conveyor on both the carrying and the return idlers. Running off center may be caused by four factors: (1) unevenness in the belt; (2) belt too stiff to trough properly; (3) failure to load material onto the center of the belt; and (4) misalignment of machinery or structure.

"If one part of the belt runs true and the other part runs out, it indicates that the belt itself is not straight. But it is extremely unlikely that a rubber belt made by an experienced manufacturer will be built crooked. However, a belt stored with the roll telescoped may develop a crook which will take some time to work out. In most cases what appears to be a

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DAYS RUN GALLONS USED GALLONS PER DAY
Oil A 251 324 1.29
StanoCyl "D".. 242 216 .89
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crook may be a splice made off-square. The remedy is to make a new splice, butting the ends of the belt at exact right angles to the edges. A bad splice causes uneven tension and should be corrected promptly to avoid permanent injury to the belt. Good contact with all idler pulleys is essential to a straight-running belt. When a belt is too stiff to trough properly it is likely to have been improperly specified.

"If the belt runs out regularly when passing over a certain section of the conveyor then the installation or loading is responsible. Material should be loaded onto the center of the belt and distributed evenly over its surface. A side chute delivering material at an angle to the direction of the belt travel or a straight-on chute with a side flow, particularly in cases of fluctuating load or wide range of sizes in the feed, is very difficult to design or adjust for all conditions. Proper chutes play an important part in training a belt and helping belts to give maximum service.

"The proper alignment of machinery and structures is an elementary essential of straight-running belts. Extreme care should be taken, first, to see that the structures are straight and adequately supported, and second, to mount all pulley outfits and idlers in line and straight with the belt. Most manufacturers provide slotted holes in idler bases or brackets to permit them to be adjusted to minor inaccuracies of alignment. When a belt runs off center, try loosening and adjusting the idlers at the point where it runs off. If the troughing idlers are mounted on tilted bases, be sure that they are installed so that they tilt in the direction of the belt travel. Reversible conveyors must be equipped with idlers mounted vertically or on special reversible tilting bases. There are many cases where the conveyor cannot be successfully corrected by mechanical adjustments. Then a simple and reasonably inexpensive way of preventing crooked-running belts is to use training trough and training return idlers."

Simple Precautions Promote Blasting Safety

"Better methods, the best equipment, and everlasting vigilance and care mean greater safety," declares the Atlas Powder Co., Wilmington, Del., in offering a pamphlet entitled "Ways and Means to Greater Safety" in the use of explosives. Suggestion 1 covers priming methods. In indirect priming, the company points out, the cap is placed in the first cartridge at the back of the hole, as in Fig. 1. Upon detonation, the borehole acts as a gun barrel, shooting hot gases out into the room. In direct priming, the cap is in the last cartridge pointing into the charge (Fig. 2). The explosive wave, traveling toward the back of the cut, acts as a gaseous stemming and reduces the gun-barrel action of the borehole. "For this reason, direct priming is safer in the presence of firedamp."

Pointing the detonator into the charge is recommended in Suggestion 2. When fired, the end of the cap shoots like a bullet. When pointed toward the rest of the charge this bulletlike action of the cap end reduces misfires. For example, an explosive wave which failed to fire across a 7-in. air gap when the cap was pointed *away from* the other cartridge shot across a 14-in. air gap (Fig. 3) when the cap was pointed *to* the other cartridge.

Fig. 1—Indirect priming promotes "gun-barrel" action.

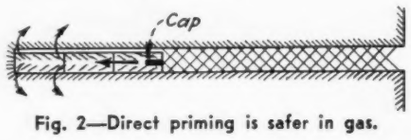


Fig. 2—Direct priming is safer in gas.

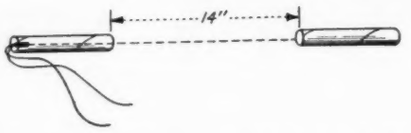


Fig. 3—With the cap pointed toward the other charge, it shot across a 14-in. air gap.

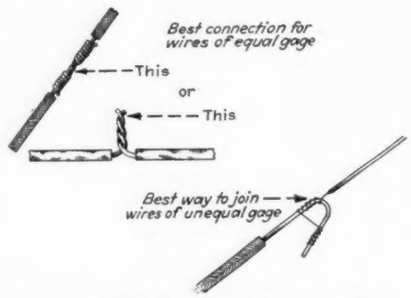


Fig. 4—Suggestions for tight connections.

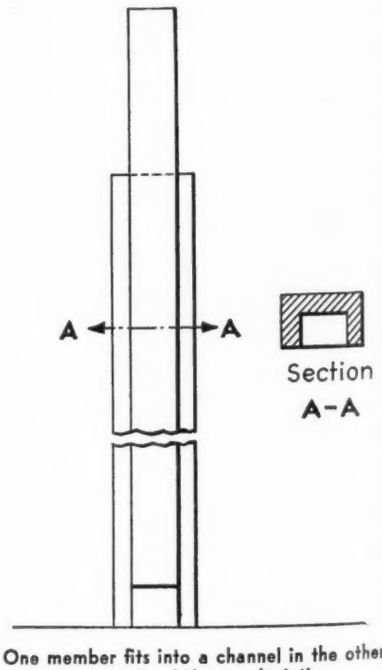
Open circuit
If the galvanometer registers, there is leakage in the lead wires
Open circuit
Warning
Bury the cap in the ground
If the cap fires, there is current leakage
Closed circuit
If the galvanometer does not register, the wires are broken

Fig. 5—Suggested methods of testing lead wires.

"Make tight connections" is the theme of Suggestion 3. Methods of doing this are shown in Fig. 4. "Use good blasting machines," declares Suggestion 4. Battered, wet or split blasting machines don't deliver the "juice"—cause misfires. Operate blasting machines properly is recommended in Suggestion 6, while Suggestion 7 urges the use of good lead wires. Worn wires leak current and cause misfires. Lead wires should be tested, according to Suggestion 7. Testing methods are outlined in Fig. 5.

Straight-Line Measuring Rod Facilitates Timber Cutting

Definite advantages over the usual method of holding two sticks together in taking measurements for cutting a timber are noted for the measuring rod shown in the accompanying illustration by John E. Hyler, Peoria, Ill. The larger member in the improved measuring rod is channeled out on one side so that the smaller will lie in it with an easy sliding fit. "It will be appreciated," says Mr. Hyler, "that when the lower end of this device is set on the floor and the smaller member is slid upward until it strikes the roof there can be no twisting or deviation when the two members are clamped together." A small clamp is used for the latter purpose and is applied at any convenient point. If a cap piece with a standard thickness is used, the measuring rod can be further improved by running a line across the end of the small member at a point corresponding to the cap thickness. Then the actual timber length can be determined by measuring to the line.



One member fits into a channel in the other to prevent twisting or deviation.

WORD FROM THE FIELD

A.S.T.M. Favors Numerous New Standards

With more actions being taken on standards than at any other meeting and with an attendance of 1,354, the 42d annual meeting of the American Society for Testing Materials, held June 26-30 in Atlantic City, N. J., was noteworthy. All told, 116 tentative specifications were recommended for adoption as standard, and revisions of standards which had been published previously for consideration are to be referred to letter ballot for adoption in 101 standards.

In conjunction with the meeting, there was sponsored the fifth exhibit of testing apparatus and related equipment, with a large number of new items displayed for the first time. Several society committees and a number of government and research institutions participated with special exhibits.

While no changes in the standards developed by Committee D-5 on Coal and Coke were considered necessary, the group on dustiness had developed a proposed test intended for determining the relative index of the dust produced when handling coal and coke. The committee took action to submit this to letter ballot and present it to the society in August for approval as a new tentative test.

New officers elected are: president, H. H. Morgan, manager, rail and fastenings department, Robert W. Hunt Co., Chicago; vice-president, G. E. F. Lundell, chief, Chemistry Division, National Bureau of Standards, Washington, D. C.

Rules on Safety Work

Elmer F. Andrews, Administrator of the Wages and Hours Act, informed Dan Harrington, chief of the health and safety branch, U. S. Bureau of Mines on July 9 that time voluntarily spent by mine workers after regular hours of employment in attending safety meetings or as part of a general safety program sponsored by a government agency will not as a general rule be considered as working time under the Fair Labor Standards Act. The Administrator added, however, that different considerations applied to mine rescue work.

To Build Utah Coal Plant

Plans for construction of a new preparation plant for the Utah Fuel Co. at Castle Gate, Utah, immediately south of the company's present tipple were announced on June 27. According to Moroni Heiner, president and general manager, more than $300,000 will be expended on the plant and for mine modernization during the summer. Contract has been let to the Link-Belt Co. for construction of the plant, which will be capable of washing, cleaning and sizing 4,000 tons per day. The Link-Belt Simon-Carves system will be used. Four months will be required for completion of the work.

Keeping Step With Coal Demand

Bituminous Production

Week Ended	1939 (1,000 Tons)	1938* (1,000 Tons)
May 6	2,752	4,673
May 13	1,071	5,023
May 20	5,125	4,954
May 27	6,210	5,324
June 3	5,860	4,691
June 10	6,403	4,937
June 17	6,460	5,049
June 24	6,500	5,108
July 1	6,738	5,280
July 8	5,972	4,688
Total to July 8	162,588	151,796
Month of June	**28,506**	**22,507**

Anthracite Production

May 6	1,477	823
May 13	1,463	1,089
May 20	924	1,089
May 27	825	1,288
June 3	757	1,128
June 10	828	898
June 17	753	726
June 24	736	962
July 1	866	991
July 8	484	325
Total to July 8	27,080	36,505
Month of June	**3,531**	**4,450**

* Outputs of these two columns are for the weeks corresponding to those in 1938, although these weeks do not necessarily end on the same dates.

Bituminous Coal Stocks

	(Thousands of Net Tons) June 1 1939	May 1 1939	June 1 1938
Electric power utilities	6,679	7,642	8,201
Byproduct coke ovens	2,637	4,434	4,867
Steel and rolling mills	512	803	722
Railroads (Class 1)	5,109	6,387	4,996
Other industrials†	7,543	8,960	8,962
Total	27,480	28,226	27,748

Bituminous Coal Consumption

	(Thousands of Net Tons) May 1939	April 1939	May 1938
Electric power utilities	3,056	2,827	2,803
Byproduct coke ovens	3,383	4,114	3,236
Steel and rolling mills	648	823	603
Railroads (Class 1)	5,921	6,042	5,609
Other industrials†	7,523	8,584	7,623
Totals	20,531	22,390	19,874

† Includes beehive ovens, coal-gas retorts and cement mills.

Delaware River Hydro Plans Fought by Coal Men

Anthracite and bituminous coal interests were joined by coal-carrying railroads and other industrial groups on July 12 in overwhelming opposition to proposed construction by the Federal Government of three hydro-electric and water-supply dams in the Delaware River near Easton, Pa. An army engineers' hearing on the $30,000,000 project held in Philadelphia was the occasion for the outburst. In speeches and telegrams, the scheme was assailed as both impracticable and uneconomic, foreshadowing a "little TVA."

F. F. Estes, traffic manager of the National Coal Association, asserted that the Roosevelt administration, encouraged by its success in being allowed to expend public funds for developing hydro-electric power projects in the Tennessee Valley and other areas, "now had extended its political eyes in the direction of the Delaware River." Furthermore, he charged that in the development of the Tennessee Valley there "has never been a report or accounting made to show that hydro-electric power can be generated cheaper than by steam if the debits are properly charged and bookkeeping is done on a sound and businesslike basis."

The anthracite industry, represented by Louis C. Madeirs 3d, executive director, Anthracite Institute, charged that at least 5,000 hard-coal miners would be forced to join the 60,000 already unemployed in the anthracite region if the dams were constructed. Anyhow, he added, investigation showed that installed capacity of steam-electric plants in the affected area already is in excess of requirements for some time to come. Railroad representatives said that revenues from hauling anthracite would suffer severely if the plan was carried out.

New Preparation Facilities

COLCORD COAL CO., No. 2 mine, Stickney, W. Va.: Contract closed with Robins Conveying Belt Co. for four-track tipple to be equipped with an adjustable duplex shaking feeder handling 200 tons of mine-run per hour; 36-in. x 159-ft. inclined hood-covered belt conveyor; special double-deck suspended Gyrex screen with intermediate steel-plate collecting deck to prepare +5-in. lump, 3x5-in. egg, 1¼x3-in. nut and 0x1¼-in. slack; Robins vibrating transfer chute; both lower decks of screen and chute to have integral slate lickers; two short 24-in. belt conveyors for transferring coal to loading booms, and hinged loading chutes and 14-in. belt conveyor

for transferring slate; to be completed late in September.

MONITOR CO., INC., Eckley, Pa.: Contract closed with Chance Coal Cleaner for washery to recover coal from banks in vicinity of Hazelton; equipment to include one 12-ft.-diameter Chance cone for washing buckwheat and larger; entire plant to have capacity of receiving bank material at rate of 200 tons per hour and a clean-coal capacity of approximately 750 tons per shift. In addition to the Chance installation, the breaker also will include two DuPont classifiers for rice and smaller sizes.

SENECA COAL & COKE CO., Catoosa, Okla.: Contract closed with McNally-Pittsburg Mfg. Corporation for crushing and re-screening plant for preparation of stoker coal; capacity, 150 tons per hour; to be completed in October.

TRNUX-TRAER COAL CO., Forsythe mine, Elkville, Ill.: Contract closed with McNally-Pittsburg Mfg. Corporation for McNally-Norton washers with capacity of 600 tons per hour, using two boxes; also facilities for crushing all coal to 7x0 in. when desired and classifying into seven sizes and loading on seven tracks; this in addition to existing tipple; to be completed about Dec. 1.

Compromise Ends Strife In Harlan Field

Peace was restored in Harlan County, Kentucky, where labor disturbances had been rife for several weeks, when union miners and coal operators composed their differences on July 19. After conferences for five days with Federal conciliators at Knoxville, Tenn., representatives of the United Mine Workers and the Harlan County Coal Operators' Association adopted a seven-point agreement to run until March 31, 1941. The union receded on its demand for a "union shop" and the operators waived the "strike penalty" clause and agreed to withdraw eviction proceedings against all miners.

Included in the agreement are recognition of the U.M.W. as exclusive bargaining agent for all employees of members of the association except exempted classes; submission to an arbitration board of disputes arising from collection of union dues which cannot be settled otherwise; agreement by the association in good faith to cooperate with the union in securing convenient and adequate meeting places for the local unions, and immediate return to work of all employees to their respective mines without discrimination or prejudice, no new employees to be hired until all old employees have an opportunity to work.

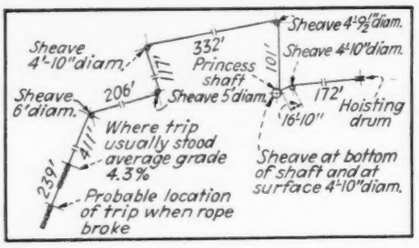
NLRB Amends Rules

The National Labor Relations Board announces that it has ordered amendment of its rules and regulations to permit employers to petition the Board in representation cases where two or more bona-fide labor organizations claim a majority but neither petitions the Board for certification. It also was stated that the rules would be amended so that the period of notice of hearing in unfair-labor-practice cases shall be not less than ten days.

Safety for Man-Trips Main Study of Mining Society of Nova Scotia

AN ACCIDENT at Princess Colliery, Sydney Mines, Cape Breton, Dec. 6, 1938, in which 26 cars, each carrying about twelve men, ran away and traveled over 5,000 ft., out of 7,000 ft. of a long slope, down a 4 to 8 per cent gradient, killing 21 men and injuring 80 or more others, was the outstanding subject for discussion at the fifty-second meeting of the Mining Society of Nova Scotia, held June 21-22 at Pictou Lodge, Pictou. Consonant with this was a discussion on care and maintenance of wire ropes. Other papers with a coal angle related to carbon tetrachloride in coal mining, experiments in mountain building and modern steam boilers.

Evidence showed or seemed to show, said A. E. Cameron, Deputy Minister of Mines of Nova Scotia, speaking for himself and G. S. Farnham, metallurgist, Department of Mines and Resources, Ottawa, that the rope—a six-strand, seven-wire, plow-steel, hemp-core, right-hand Lang-lay, 1-in. rope installed Aug. 28, 1937, about fifteen months before the accident—broke at one of two apparently self-formed loops within 5 ft. of each other which had been in the rope several months prior to the accident.



Turns in the rope at Princess Colliery, where the almost invisible kink (that is believed to have been one cause of the accident in which 21 lives were lost) is said to have occurred.

Actuated by a corliss engine on the surface with a drum of length and diameter both 8 ft., the rope passes along a trench from the underside of the drum to the top of the shaft, where it passes over a sheave into a vertical box 4 in. square to the shaft bottom, a drop of 670 ft. Here, to keep it clear of the haulageway, the rope passes round four other sheaves, as shown in Fig. 1, before it leads down the man slope. On the last two sections, pulleys or rollers on the roadside support it. In the other sections, the rope is inclosed in a wood box like that in the shaft or is supported on a shelf cut in the rib, so that even when slack it will not leave that projection. It is boxed into and out of each sheave, and nowhere between engine-house wall and slope could it get loose and loop itself.

The man slope leaves the haulage road about 700 ft. from the shaft bottom. For 1,500 ft. it slopes across the dip of the seam with an average gradient of 4 per cent, then turns left 60 deg. and continues to run down across the dip on an average gradient of about 8 per cent. No one knows how the trip at the time of the accident made the turn without derailing many of the cars.

At this turn it slowed and many men, perhaps over a hundred, leaped to safety. Most of the few derailed cars were rerailed by a device, but at least one of the rear cars, perhaps the last, remained off for the rest of the run. Derailments of the rear cars acted as a brake just before the final crash and saved the lives of many who remained aboard.

After a new rope was installed, tests were made in which slack was provided by unwinding the drum when the cars were blocked so that they could not run down the slope or else by derailing the cars, thus stopping them suddenly. These trials failed to cause loops or kinks in the rope within the mine, but several feet of rope unwound on the floor of the engine house, because the engineer could not stop the drum quickly enough. The unwinding of this rope could have formed a loop.

Most Undesirable Kink

A kink forming from a loop on the right-hand side of a rope having a right-hand lay will shorten the rope, tighten both the strands and the wires and deform the rope more permanently and in a greater degree than a kink forming from a loop on the left-hand side of a rope having also a right-hand lay, for this type of loop will tend to unravel the strands and individual wires and lengthen the rope. A right-hand kink on a right-hand-lay rope, because it shortens the rope and tightens the strands, affects only a short length of rope and slightly decreases its diameter and thus is much less apparent than a left-hand kink, yet it does much more damage.

Greased by a box lubricator just below the sheave at the top of the manrake road, the rope, continued the authors, obviously soon wore a tubular tunnel through the thick axle grease and thereafter only casually made contact with it until it was replenished. Hence tests showed insufficient lubrication, for none of the grease squeezed out during the tension test, and a cloud of iron oxide came from the rope whenever it was broken in the testing machine. Only 4.6 per cent of oily material was chemically separable from the old rope and 14.1 per cent from new cable.

The part of the rope which was pulled down the slope by the trip was doubtless damaged in passage; its condition after the accident, therefore, furnishes questionable evidence. The upper end of the rope at the break showed clearly a right-hand kink. Five feet below the break, the rope was severely damaged and had several corroded hooked ends showing a left-hand kink on this right-hand-lay rope. Broken ends of wire in both kinks were rusted, showing that the breaks in the wires were old.

According to the authors, the disastrous right-hand kink was made August, 1938, when a splice made Nov. 12, 1937, appeared unsatisfactory and was replaced by a new one. To make the splice, the

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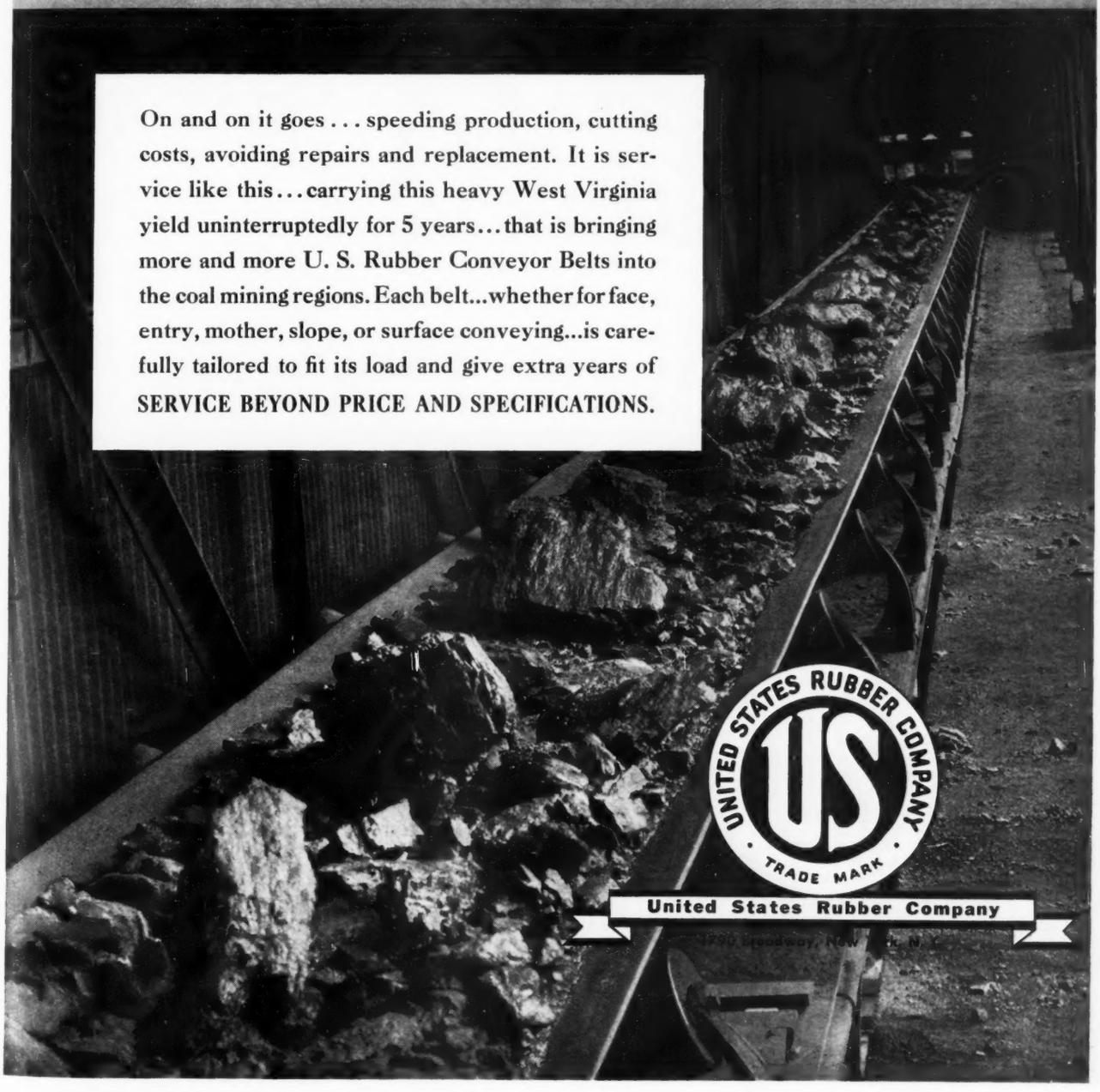
Most of Belt Runs Underground... Must Resist Temperature Changes; Iced Surfaces in Winter; Heavy Blows Due to Large Lumps...Yet in Five Years This 38-in., 7-Ply U. S. Giant Conveyor Belt Has Brought Out 3,000,000 Tons of Run-of-Mine Coal (Large Lumps)... and Still Asks For More!

On and on it goes... speeding production, cutting costs, avoiding repairs and replacement. It is service like this... carrying this heavy West Virginia yield uninterruptedly for 5 years... that is bringing more and more U. S. Rubber Conveyor Belts into the coal mining regions. Each belt...whether for face, entry, mother, slope, or surface conveying...is carefully tailored to fit its load and give extra years of SERVICE BEYOND PRICE AND SPECIFICATIONS.



rope had to be given slack, and small loops could form in this slack rope without the splicer realizing that fact. After the splice was made, he would telephone the engineer to take up slack so that the blocked cars on the lower end of the rope could be released. A loop above the splice would be invisible in the dark, and the stretch on the rope would pull it into a kink.

At intervals usually of a week, the rope would be examined by the mechanical superintendent. He would wrap a piece of cloth or waste around his hands and feel the rope as it passed between them. "These examinations," say the authors, "did not reveal the presence of kinks in the rope, and this fact shows that the whole procedure of rope examination was not sound." They did not say, however, how it could be improved unless by electrical methods, such as the Phillips Suschyzki testing machine recently exhibited in London.

The daily examination of all ropes by which men are hoisted was made by a rope examiner who checked all splices and held a stick against the rope at a sheave to detect broken wires on the lower part of the rope by their clicking against the sheave and at the top half of the rope by the feel of the stick against the wires. In later discussion, both Dr. Cameron and D. T. Morris, wire-rope engineer, Canada Wire & Cable Co., declared that they were not informed as to the success attained thus far in electrical testing of hoisting ropes.

Should Wires Be Large?

All the properties sought in rope often cannot be obtained with a single form of construction, asserted Mr. Morris. Large wires resist abrasion; small wires do not, but provide flexibility and resist fatigue. Though the grade of steel mainly determines strength, construction enters into it in some degree. The author showed a table in which it was stated that 6x7 ropes should have sheaves of 40 to 43 times the diameter of the rope or over, but added that this table applied to general purposes. Mine-hoist sheaves should have twice the diameter given. Head sheaves should be 80 to 90 times the rope diameter to reduce combined bending and vibration stresses to a minimum. The required ratios of diameter of sheave to diameter of rope indicate the relative flexibility of the several ropes.

Strength, hardness and resistance to abrasion are allied qualities of the higher grades of steel, but, with such steels, resistance to bending fatigue declines. However, this can be compensated by increased sheave and drum diameters. Abrasion resistance and flexibility are somewhat greater with Lang-lay than with regular lay, because with it a greater length of wire is exposed and the wires are inclined to the rope axis 30 to 37 deg. instead of being parallel to the axis.

Lang-lay rope has a strong tendency to untwist and form loops which may become kinks, but this can largely be obviated by preforming the strands during fabrication by the Tru-lay process so that they are formed into the final shape they will have in the rope before they are actually closed around the core in the rope manufacture, stated Mr. Morris. It is asserted that preforming of rope reduces rope fatigue and relieves the internal stress built up during stranding and closing operations.

Lang-lay rope should not be used where the rope may be free at times to untwist, loop and kink, or when in operation the rope may be slack and thus free to act in a like manner. Being less resistant to crushing than regular lay, Lang-lay rope should not be used where many layers are reeled on a drum, and a rope to be thus used or to be subjected to irregular or cross winding should have a steel strand core, as a hemp center may crush. However, the steel center has the disadvantage that it is working against steel.

Arthur E. Flynn
President-elect, Mining Society of Nova Scotia; Professor of Mining, Nova Scotia Technical College.

As a precaution against a shutdown from rope failure, a spare rope is often ordered as soon as an installation has been made, added Mr. Morris. In such cases, atmospheric corrosion may deteriorate it. The spare rope should be inspected and, if necessary, liberally coated with grease before storing. For such storage, a clean, dry place, free of smoke and fumes, should be chosen, and the rope examined periodically and, when needed, should be greased. It should be kept clear of the ground, especially cinders. Once started, corrosion will continue.

To preserve the rope, maintain the equipment on which it works. Sheave bearings should not wobble or get out of line. Ropes should not be irregularly or cross wound and should not pile up at a flange. Sheaves with broken flanges should be replaced, as they are a hazard to the rope. Sheave grooves improperly designed support it inadequately. They may wear so that the rope is pinched, making necessary an early replacement of the latter. Their condition should be checked and, if necessary, they should be machined. A new rope is slightly larger than its nominal diameter, but will pull and wear down in service. An old rope will wear down the groove because of the rope's reduced diameter, and the groove no longer will suit a new rope. British standards require that rope circumference should not be more than 2 per cent under or 5 per cent above the nominal circumference. Within that range, the rope will not be injured if the grooves are correctly proportioned.

Sufficient clearance must be allowed between grooves on drums, declared Mr. Morris, so that there will be no scrubbing or abrasion between adjacent turns, as this may seriously shorten rope life. Rope rollers can be offset from each other so that the rope will run toward the right end of one and toward the left end of the other. When the rollers begin to wear they can be reversed and a new surface presented. Rubber-faced rollers have been used successfully on some installations.

Wherever the direction of the rope has to be deflected enough by a sheave that one length of lay (6.5 to 7 times the rope diameter) will bear on the sheave, the ratio of the diameter of the tread should bear the same ratio to the diameter of the rope as recommended for a drum or sheave having a larger angle of contact. Sheaves and rollers should be in balance and not so heavy that, in acceleration or retardation, they will skid on the rope.

Some authorities, asserted Mr. Morris, state that the fleet angle—between lines drawn from the center and one flange of the drum, respectively, to the center of the sheave—shall not exceed 1½ deg. for flat-faced drums and 2 deg. for grooved drums. Others allow up to 2 deg. and 4 deg., respectively. Larger angles injure the rope.

Ropes will vibrate or dance if the distance from the drum to the sheave is too great. Idler sheaves will reduce the vibration. Reverse bends in the rope fatigue it and shorten its life. Multiple layers on a drum act in the same way, for the ropes will crush and one layer will creep on the other. Under even the best conditions, creep will occur where loads vary.

In unreeling, a single tight soft-iron wire seizing three times the length of the rope diameter or three short servings, each of length equal to one rope diameter should be provided, according to Mr. Morris. Though Tru-lay ropes are easy to handle, they are not entirely foolproof. During installation, the rope should be led from the reel over the head sheave to the drum. Tension should be maintained on the rope by braking the reel throughout the winding.

Give Rope Correct Helix

On a flat-faced drum, the rope from the first should be compelled to wind at the angle that will provide the correct helix. For this, a tapered steel starting piece should be constructed to fill the space between first turn and flange. A tapered fiber packing, sometimes used, is not so dependable. Each turn should be tapped with a hammer so as to touch the adjacent turn but not interlock with it.

Care should be taken to see that the "dead turns" of the rope—those that are not unwound—are tight and true, for the sake of the turns which later are wound over them. A spot-welded tapered steel lifter should be used to lift the rope from the first to the second layer. Its position will have to be altered as stretch and wear reduce rope diameter.

After installation the rope should be run a few times under light load so that it can make its adjustments, and it should be given a thorough application of rope grease. The rope must be made to wind truly, for a few hours of ir-

TO PREVENT **FIRE** FROM OVERHEATED TROLLEY CIRCUITS

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The Type ETB Trolley Wire Protector comes complete in a hinged, sheet steel enclosure with outside operating handle and provision for pad-locking.

The Type ETB Trolley Wire Protector is a 500-ampere, 275-volt, 2-pole, manually operated circuit breaker adapted for mining applications.

Similar devices, employing the same type of I-T-E circuit breakers, are widely used in other industries for protection against damage from overheated lighting and power circuits.

The thermal tripping characteristics of the circuit breaker are such as to prevent the continuance of any dangerous, overheated condition on 4/0 trolley circuits now generally used for branch lines. The circuit breaker is also provided with an instantaneous trip mechanism which opens the circuit when short circuits or high current values are encountered.

Bulletin 3909 describes and illustrates the design and operating features. A copy will gladly be sent at your request.

Representatives in Principal Mining Areas.

I-T-E CIRCUIT BREAKER CO., PHILADELPHIA, PA.

regular winding will seriously damage it, urged Mr. Morris.

Clamp sockets at the ends of hoisting ropes have 70 to 80 per cent efficiency, but metallic socketing may give from 25 to 100 per cent, depending on the workmanship. Most authorities recommend that pure zinc be used and, considering the short basket provided in standard sockets, its use probably is advisable. A British specification for capping wire ropes for colliery and general purposes is 5 per cent tin, 15 antimony, and 80 lead. With babbitt metals the length of basket should not be less than six times the rope diameter. No matter what metal is used, the individual wires should be well tinned before the metal is poured. The U-bolts on all the clips in clamp sockets should bear on the dead end of the rope.

Splicing may cause a twist and later a kink to be formed in a rope, warned Mr. Morris. Many regulations forbid use of a spliced rope where human life rests on perfection of splice. Clamp attachments can be examined, and in the Ontario and Quebec mine fields poured sockets have been abandoned for mine-hoist ropes in favor of wire-rope clips and solid thimbles. Some operators use a special clamp to form the rope tightly around the thimble.

Dead Turns on Drum Slacken

Dead turns on a drum stretch under tension and become slack and, to make the rope wind evenly over them, they should be rewound to prevent the upper layers from wedging the lower layers apart. If the rope is too long to permit the dead ends to be wound off the drum by lowering the cage to the limit of the shaft, the dead rope can be tightened by rigging a sheave on the top of the cage, reeving the rope through it and fastening the end to a timber at the surface. The cage is lowered until the rope is unwound to the last turn, then rewound under tension which can be controlled by the loading on the cage. When, to clear the drum, the end of the rope is hauled along a heading, mechanical injury to the rope is likely to result.

As a new rope, especially a Lang-lay rope, stretches in operation, it tends to untwist, said Mr. Morris. Some say this twist should be released or the rope may loop or kink when the cage rests on its chairs, and the rope accordingly slackens. Apparently a spin develops when a new rope runs over the head sheave. However, no loops or kinks have occurred and in letting out a spin more may be removed than is desirable, for some is really normal in the rope. A good practice at some installations is to cut off a half circumference on the drum at three-month intervals, changing the whole position of the rope relative to the drum, exposing different sections to severity of wear such as occurs when the rope rises from first to second layer, also at cross-overs, etc.

Mine-hoist ropes should not be turned end for end, as fatigue and corrosion generally are more severe at the bottom and reversal places this weaker section as dead turns on the drum. Corrosion proceeds both in wet and dry locations and, as the exact condition of this weakened section is unknown, an accident might occur if endeavor were made to wear out the entire rope. Some operators order ropes longer than required and periodically cut off a short length from the working end to change the relative position of rope to sheaves.

Corrosion is self-perpetuating, in the opinion of Mr. Morris; hence it should be stopped at the start by lubrication. Galvanizing is easily scratched or worn off, providing thereby a small galvanic cell that accelerates corrosion. After fabrication, it is impossible practically to lubricate the center, for the space between outer wires of a new rope is only two- or three-thousandths of an inch and between strands less than fifteen-thousandths.

Lubricants for high-speed ropes must be adhesive or they will fly off. On endless haulage, they must be "tacky" so as to prevent slippage on driving sheaves. In flat haulage work, they should be light oils so that they will not gather material from the floor. Loose wires may indicate severe internal corrosion. In themselves they are as useless as broken wires, as they do not carry their share of the load. The Ontario Department of Mines orders the removal of rope when the elongation of the 60-in. test piece falls below 2 in. Experience justifies this much-debated ruling. Lack of ability of a rope to elongate on tension is the best measure of its fatigue.

"Fire extinguishers of the carbon tetrachloride type are of value for putting out small fires such as might occur in a haulageway where there is good ventilation," asserted H. S. King, associate professor of chemistry, Dalhousie University. "Where there is little ventilation, their use should be discouraged and/or extra precautions taken." Two men in the U. S. Navy Department were killed by this chemical and one in the U. S. Bureau of Mines was overcome when fighting a fire. Tests made by applications to fires and to hot metal in a 1,000-cu.ft. room and by passing vapors in air through heated tubes of iron or quartz with humidity and temperature controlled showed the presence of the poison phosgene, chlorine (also poisonous), hydrogen chloride (irritating and poisonous) and vapor of carbon tetrachloride (a dangerous anesthetic in considerable quantities). The reactions are

$$CCl_4+H_2O=COCl_2+2HCl$$
$$2CCl_4+O_2=2COCl_2+2Cl_2.$$
$$3CCl_4+Fe_2O_3=3COCl_2+2FeCl_3$$
$$2CCl_4+Heat=C_2Cl_4+2Cl_2$$
$$CCl_4+2H_2O=CO_2+4HCl.$$

The U. S. Bureau of Mines in sixteen later experiments in which excelsior fires were extinguished by carbon tetrachloride in a sealed chamber found 4 to 92 parts per million of phosgene by volume and an average of 23.6. Dropped on an I-beam heated to a red heat, 119 p.p.m. was found. The Chemical Warfare Service found that 30 minutes' exposure to 25 p.p.m. of phosgene is fatal to man. A report sponsored by the Diamond Alkali Co., Dow Chemical Co., Niagara Smelting Corporation, Pennsylvania Salt Manufacturing Co. and Westvaco Chlorine Products, Inc., recommended that concentration should not exceed 100 p.p.m., which gives a barely perceptible odor in coming from fresh air. Continuous exposure damages liver and kidney cells, but others are formed that usually are more resistant.

When to Use Tetrachloride

"Carbon tetrachloride fire extinguishers undoubtedly are of value in coal mines," asserted Dr. King, "provided they are used intelligently and that the danger involved in their use is known. If those in charge were aware of the danger, they would not make the mistake of ordering men without suitable protection such as gas masks into an area contaminated with poisonous fumes." Heat of glowing tobacco or even sunlight will liberate phosgene from carbon tetrachloride.

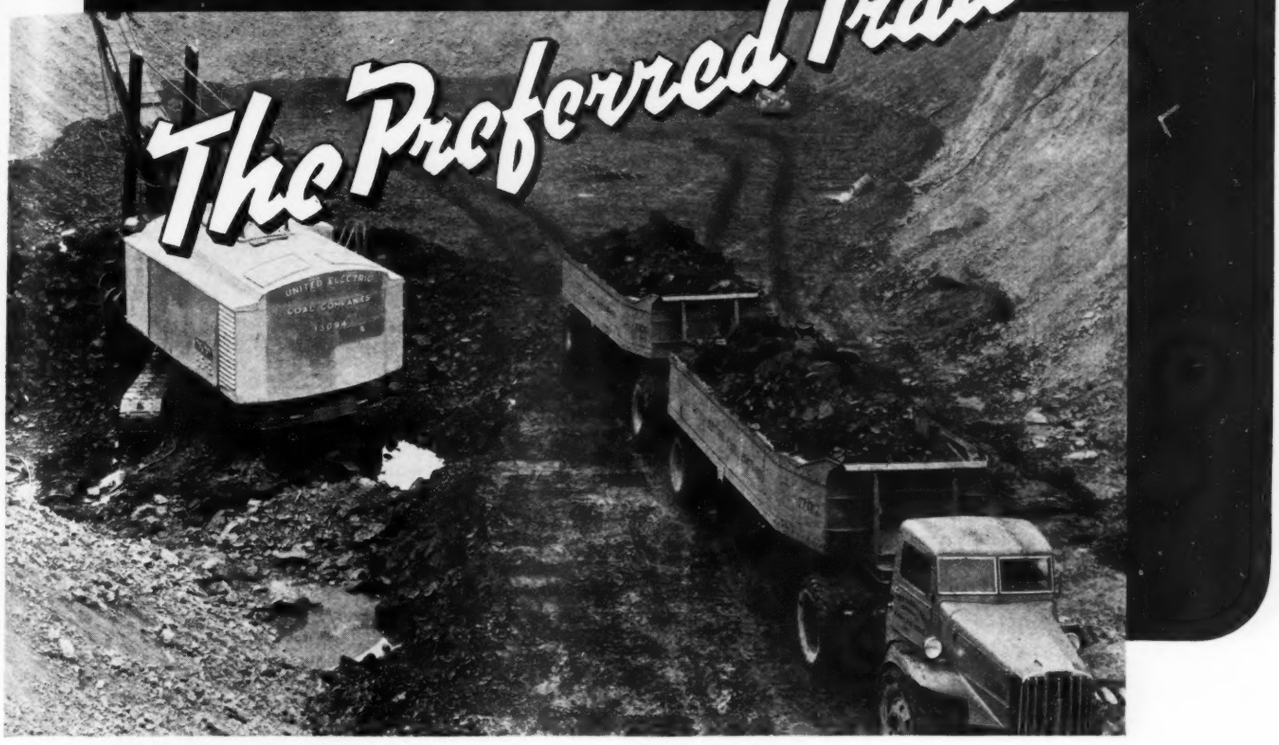
Overthrusts (rocks that are lifted up and fall back; that is, lean backward) appear to be the formations usually resulting when rock is placed under horizontal compression, according to an article prepared presenting deductions drawn from tests of models composed of layers of sand, cement and rouge, and presented by G. V. Douglas for himself and Geddes Webster, of the department of Geology, Dalhousie University. Folds which lean back and planes of shear are, they assert, more easily developed than symmetrical anticlines and synclines.

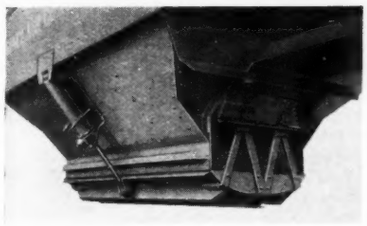
Overthrusts, it may be added, may be usual, when folds are made speedily and with a force comparable with the ultimate strength and weight of the strata, yet possibly may not be so assured when the strata are stronger in relation to the push and weight of the measures and when the process spreads over several periods of geologic time. R. E. MacAfee, manager, eastern branch, Babcock-Wilcox

MASTERS OF CEREMONIES, 1939-40, MINING SOCIETY OF NOVA SCOTIA

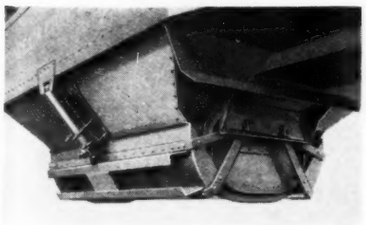
President, A. E. Flynn, professor of mining, Nova Scotia Technical College, Halifax; first vice-president, H. B. Gillis, mining engineer, steel division, Dominion Steel & Coal Corporation, Sydney; second vice-president, G. G. Bowser, manager, explosives division, Canadian Industries, Ltd., Halifax; secretary-treasurer, Sydney C. Mifflen, office engineer, Dominion Coal Co., Ltd., Sydney; Councillors, J. L. Bowlby, analytical engineer, Dominion Coal Co., Ltd., Glace Bay; T. J. Casey, chief inspector of coal mines, Department of Mines, Halifax; J. R. Dinn, district superintendent, Dominion Coal Co., Ltd., Glace Bay; M. Dwyer, president, Acadia Coal Co., Ltd., Stellarton; H. C. M. Gordon, assistant to the general manager, Dominion Steel & Coal Corporation, Sydney; Dr. F. W. Gray, assistant general manager, Dominion Steel & Coal Corporation, Sydney; A. L. Hay, assistant mining engineer, Dominion Coal Co., Ltd., Sydney; H. Hines, district superintendent, Dominion Coal Co., Ltd., New Waterford; H. J. Kelley, vice-president and general manager, Dominion Steel & Coal Corporation, Sydney; A. R. Lawrence, director, Mines Apprentice Project, Halifax; J. P. Messervey, inspector, metal mines, Department of Mines, Halifax; T. L. McCall, chief mining engineer, Dominion Steel & Coal Corporation, Sydney; J. W. McLeod, general manager, Greenwood Co., Thorburn; J. C. Nicholson, general superintendent of coal mines, Dominion Steel & Coal Corporation, Sydney; Dr. F. H. Sexton, president, Nova Scotia Technical College, Halifax; W. L. Stuewe, mechanical superintendent, Dominion Coal Co., Ltd., Glace Bay, and ex officio Dr. Alan E. Cameron, Deputy Minister of Mines, Halifax.

FEATURES LIKE THESE MAKE "WESTERN" The Preferred Trail Car





• The truck operator controls the opening and closing of the doors; no special device is necessary at the hopper.



• When open, "Western" doors are entirely in the clear. Permit tipple hoppers to be filled right to the top. Provide sufficient clearance for loads to be dumped any place.

● It is more than a coincidence that open pit coal mine operators—who buy haulage equipment on the basis of lowest cost per ton—use more "Western" Trail Cars than any other make of semi-trailer.

Outstanding among the features these operators list as important factors in their preference for "Western" Units are: (1) The distinctive "Western" body designed for free discharge of large chunks, material does not hang up or clog; (2) the unobstructed bottom discharge opening that dumps each load in record speed, a feature of the time-proved "Western" air controlled clamshell doors that open outward and upward. These positive, quick-acting doors, say leading mining executives, are most dependable under all conditions. They permit the load to be dumped on the fly, need no clearance space when opened, are always positive in their opening and closing action, permit tipple hoppers to be filled right to the top . . . and give round-trip productiveness because their ground clearance permits handling gob on the return trip for low cost road maintenance. Specially designed to meet your layout requirements, these "Western" Trail Cars can be built with water level capacities up to 60-tons per trailer. For convincing proof that "Westerns" outperform, investigate their on-the-job records for leading strip mining companies. The Austin-Western Road Machinery Co. (formerly Western Wheeled Scraper Co.), Aurora, Ill.

Austin-Western

& Goldie-McCulloch, Ltd., described the Integral furnace boiler, detailing all its features.

In the absence of the president, Dr. D. F. MacDonald, professor of geology, St. Francis Xavier University, Antigonish, N. S., on a trip to Panama, the presiding officers were Dr. F. W. Gray, assistant general manager, Dominion Steel & Coal Corporation; A. E. Flynn, professor of mining, Nova Scotia Technical College; A. F. Cagney, Peacock Bros., and J. P. Messervey, inspector of metal mines, Nova Scotia Department of Mines. At the opening session a plaque with a likeness of E. Rudolphe Faribault and in his honor, the work of Dr. Gray, was unveiled. Dr. Faribault has conducted geological research for 51 years in the province of Nova Scotia, and his prognostications have been confirmed by later explorations.

Mechanical Loading Vies With Safety As Rocky Mountain Theme Song

RUBBER-TIRED haulage stole the program of the 37th regular meeting of the Rocky Mountain Coal Mining Institute, Hotel Utah, Salt Lake City, Utah, June 22-24. This new method for handling cars behind the loading machine—as yet untried in the Far West—provoked question after question from the floor. The Neely-Keller bill for federal mine inspection was a close second in general interest. Before the meeting ended, the institute went on record with a strong resolution opposing the bill, sponsored, the delegates were told, by the United Mine Workers. Mechanical loading under no better than average conditions in Illinois was the theme of another presentation.

As in the past, safety had a prominent part in the program. Utah's outstanding record for the past year was emphasized. Sheathed permissible explosives were described. Accident-prevention work from the viewpoint of the safety engineer, State coal-mine inspector, mine foreman and fireboss was detailed. The meeting also included two historical presentations. F. W. Whiteside, secretary and a charter member, traced the history of the institute from its inception in 1912 under the leadership of William F. Murray and Floyd W. Parsons, first editor of *Coal Age*. Thomas Allen, chief State coal-mine inspector for Colorado, offered the fruits of an extensive research into the progress of coal-mine haulage from the Middle Ages.

Is Regulation Needed?

The coal industry, remarked H. C. Marchant, president of the institute, has been in and out of regulation for the past six years. First came NRA, then the short-lived original Guffey law and now the present act—on the statute books two years and still no prices. While the now defunct National Bituminous Coal Commission had been struggling with minimum prices, levels in the open market steadily declined. Opinion on the present law, he pointed out, is divided. To many, it looks as if regulation under the terms of the act is impossible and that Congress failed to realize the complexity of the coal-price structure.

Even without the Guffey act, continued Mr. Marchant, the industry is subject to regulation in wages through the force of union contracts and in operations by the various State mining laws. Stabilization without more formal regulation might help if such stabilization permitted the industry to set up some simple rules of conduct, with the government as umpire. Certainly losses estimated at $75,000,000 in 1937 and $100,000,000 last year cannot be borne indefinitely. But widespread publicity to such losses, he added, has had a bad effect on the morale of the industry and on its public standing.

Rubber-tired haulage, stated A. S. Knoizen, Joy Manufacturing Co., may be described as a secondary transportation system to increase the efficiency of the loading units. Two types are now in use—the tractor-trailer system devised by J. H. Fletcher and the transfer or shuttle car and conveyor combination introduced by the Joy company. The earlier system has proved very effective in Illinois and Indiana, where there is no pillar pulling and where it is feasible to dig dump hoppers, but the speaker questioned its adaptability where a mine is bothered with water or space for maneuvering the equipment is limited.

Sharp Hanson
President-Elect, Rocky Mountain Coal Mining Institute

Trackless mining, he said, has the further advantage that there is no loss of material in moving from place to place because there is none to recover. In the case of a squeeze, the trackless-mining set-up can be moved from the danger zone in five to eight minutes. For operating purposes, the shuttle-car system can be moved and set up again in an hour. Neither system involves laying room or entry track. Savings over the usual methods of loading from the machine into mine cars are estimated at from 10 to 25c per ton.

The major objective of trackless mining is to eliminate the difficulties normally experienced in trying to feed cars fast enough to the loading machine and so reduce idle machine-hours. It can be operated in 40-in. coal with 3-ton cars and in 7-ft. coal with 9-ton cars. Possibilities of installing the system in 36-in. coal are now being explored. The largest savings to date have been made in the lower seams. Mr. Knoizen cited labor costs of under 40c per ton from face to railroad cars and of 29c to main-line partings. Initial investment in a unit for double-shift operation approximates $22,000. Such a unit includes two shuttle cars with caterpillar mounting or truck for cutting machines and the electrical battery unit.

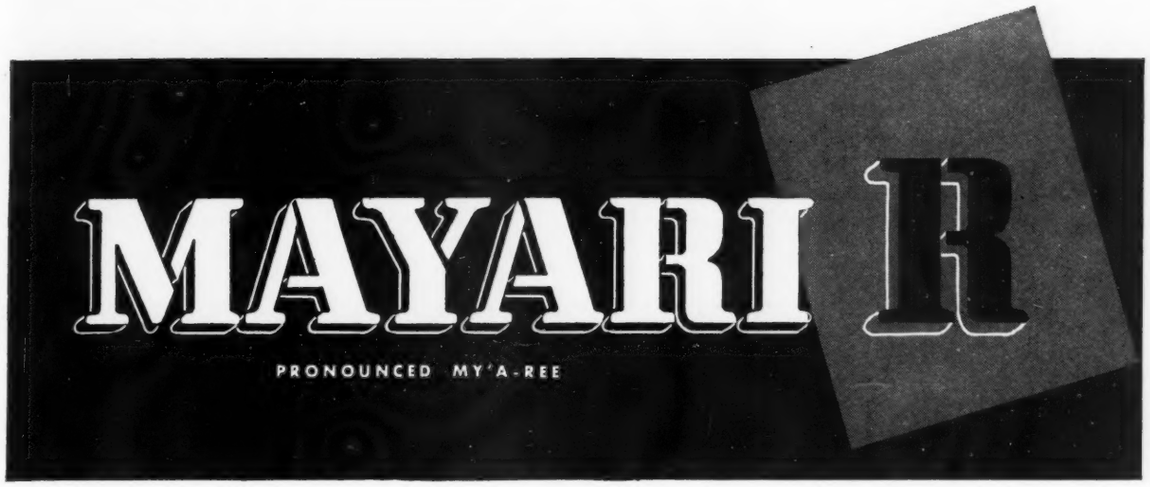
Based upon figures for 58 units, average production per man to the passway, he said, had increased from 6 to 18 tons. At one of the Consolidation Coal Co. mines with a 1,000-ft. haul, one unit was producing 600 tons per shift. The optimum distance, in Mr. Knoizen's opinion, however, should not exceed 750 ft. The longer the haul, of course, the fewer the trips the shuttle car could make. With the 750-ft. optimum, about 70 trips per shift could be made. For best operation, cutting steps should not exceed 3 in., but the equipment can be worked on a maximum grade of 12 per cent. With heavy grades, either the length of the haul must be shortened or battery capacity increased.

No Increase in Degradation

With 10- to 12-ft. coal, said Mr. Knoizen in answering questions, the maximum car height at loading point could be 60 to 66 in.; with 42-in. coal, 22in., and with 5-ft. coal, 38 in. Equipment can make a 90-deg. turn on rooms on 14-ft. centers. In low coal, it is necessary to allow about 2 ft. additional clearance. Coal handled by this system shows no appreciable increase in degradation. Mr. Knoizen explained that this probably was due to the fact that it was cushioned by coal in loading into the conveyor. Turning again to production, he added that in one southern West Virginia mine using 8BU machines working in 44-in. coal, average production per machine in the two years prior to installing the new system had been 105 cars per shift; during the first three weeks after shuttle cars were introduced, the average jumped to over 180 cars.

An average of 625 tons per shift with occasional peaks of over 700 tons is the record being made with a Goodman 360 track-mounted machine at the Lumaghi Coal Co. operation in Madison County, Illinois, said C. E. McWhorter, Denver district manager for Goodman Manufacturing Co., in a paper on track cutting and loading at the Lumaghi company. The mine is in the No. 6 seam. Coal averages 7½ ft. in height and carries two definite and persistent partings. The blue band occurs about 18 in. above the bottom and varies from ½ to 2 in. About 4 in. above this is the second parting, locally termed "steel band" and averaging about ½ in. in thickness. In addition, the presence of sulphur close to the bottom makes it advantageous to cut higher up in the seam.

The conventional room-and-pillar sys-



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tem of mining is employed, but bad top conditions make it necessary to vary standards of room depth and width from time to time. Normally the roof is gray slate, which is fairly easy to hold, but frequently white slate or soapstone is encountered. When the top is tender, crossbarring is placed to within about 15 ft. of the face. Standard posting is on 4-ft. centers, 3 ft. outside of each rail. "At times," added Mr. McWhorter, "additional posting is necessary in advance of the crossbars. When this procedure becomes necessary to hold the roof, the timbers close to the face have to be removed and then reset after the coal is loaded out." Little time, however, is lost in cleaning up the place because the machine can nose in close to the timbers before they are removed. Main and panel entries are protected for considerable distances by 14-ft. crossbars on 2-ft. centers. Depth of cover averages 200 ft.

Cut 30 In. Above Bottom

In the area served by the loader, coal is cut with a Goodman track-mounted machine. Because of the impurities previously mentioned, 18-in. shims were installed on the cutter so that it could cut about 30 in. above the bottom. This change cut down bit consumption and time lost in frequent changes of the bits, with the result that the number of places cut per shift was increased approximately 33⅓ per cent. Both cutting and loading machines average about 16 places per shift with peaks of 21 places cleaned up. Each place produces about 40 tons of coal.

Because of the change in cutting methods and the desire to obtain the best preparation for mechanical loading, considerable experimental work was done in drilling and shooting. The system now in use, explained Mr. McWhorter, calls for three top holes, two about 4 in. from the top and 18 in. from either rib and one in the center. All holes are drilled straight in to a distance about equal to the depth of the machine kerf. Five equidistant holes are placed directly on the bottom. These eight holes for a 20-ft. place are drilled in three set-ups with a Chicago Pneumatic No. 472 drill. Drill-holes are 2½ in. in diameter.

Shooting is with pellet powder. Drillers do their own tamping and also shovel away the cuttings left by the cutting machine. "Cutting 30 in. above the bottom makes it unnecessary for the machine men to shovel slack to clean out the kerf, but the drillers must shovel away all cuttings before they can drill the bottom holes." A two-man drilling crew can furnish about 35 holes per shift. Three two-man drill crews are employed to take care of the number of places the loading machine cleans up per shift.

Lumaghi uses a two-entry panel and modified checkerboard system of mining, said Mr. McWhorter. Entries are driven on 40-ft. centers with cross-overs at 45 deg. Rooms usually are 24 ft. wide on 75-ft. centers, with room crosscuts 24 ft. wide on 60-ft. centers. Where roof conditions will permit, it is the intention to drive 21 rooms on 75-ft. centers to a panel. A 100-ft. barrier pillar is left between the main entry and the No. 1 room on the panel. Rooms are driven 375 ft. deep, leaving a 50-ft. pillar between the ends of the finished rooms of each panel. Panel entries are driven 14 ft. wide. Sixty-five per cent of the coal is extracted.

Car changes, declared Mr. McWhorter, are consistently made in less than one minute of elapsed time. Switches are laid in all crosscuts, but not all switches connect with adjoining room tracks. Two Mancha storage-battery locomotives serve the loading machine. Empties are switched to the loader in groups of four and each car is spotted as it is loaded. When all four are loaded, a combination battery and trolley relay motor picks up the loads from the nearest crosscut and handles them to the main-line parting. This locomotive operates from the battery when in the rooms and from the trolley wire on the entry track. Empties brought back by the relay locomotive are placed in a crosscut or room as close to the working area as possible.

"Whenever possible, the elapsed time between car changes is utilized to maneuver the loading machine to a position that will permit it to obtain a full car of coal in one advance toward the face. Although this car change at Lumaghi is rapid, the loader usually is waiting for the empty car in order to resume loading." Wooden mine cars with steel reinforcement and equipped with Timken bearings are used. These cars are 9 ft. long, 66 in. wide and 48 in. high; they average 3½ tons when mechanically loaded. Coal is hauled from the main-line parting to the bottom by trolley locomotives. There is a run-around to permit main-line locomotives to pick up empty trips on the empty side of the cage.

The first loading machine was installed late in the summer of 1938 and a second loader of the same type has been ordered. Since the first installation "tonnages loaded have gradually increased as the mine crew became more familiar with the operation and the management made provision for rapid car changes. At the present time an average of between 175 and 180 cars per shift is secured—625 tons in the 6¾-hour loading period. An effort is made to have the room face and crosscut full of coal each time the loader enters a room. Even with such an arrangement a considerable distance has to be traveled each shift to get to these working places. The track loader moves at four miles per hour from place to place so that the moving time is not a large item of delay." The number of men in the crew varies between 20 and 25, depending upon roof conditions and the amount of timbering necessary.

Decreasing Explosion Risks

Decreasing to a minimum the risk of igniting coal dust and methane mixtures which might be present at the working face during blasting, said N. F. Wetzel, sales representative, Hercules Powder Co., has been the primary purpose in developing sheathed permissible explosives. Secondary advantages include the use of a low-density sheathing compound which provides an inherent cushioning effect, reducing shattering action in the immediate vicinity of the powder charge and increasing the percentage of coarse coal, and fumes which some believe are less objectionable than those from unsheathed permissibles. Sheathed explosives are primed by punching the end of the primer cartridge in the usual manner and loading the charge in the normal way.

Experiments to reduce the hazards of firing explosives in gassy and dusty mines were first reported in England in 1881. Methods then developed, continued Mr. Wetzel, involved devices difficult to manufacture, cumbersome to use and uncertain in their results. This, however, did not end the search. Sheathed explosives were first successfully developed by Prof. Lemaire, of Belgium, about twelve years ago. He placed his cartridge in a sheath or lining of dirt or easily pulverized material such as cement or dried clay. Since then over 10,000,000 lb. of sheathed explosives have been used in Belgium mines without an ignition of gas or dust therefrom. English mines have been using explosives of this type with similar favorable results for the past five years.

The Hercules product consists of cart-

WHO'S WHO IN FAR WEST

Sharp Hanson, president and general manager, Gallup Southwestern Coal Co., Gallup, N. M., was elected president of the Rocky Mountain Coal Mining Institute for 1939-40 at the recent meeting in Salt Lake City. F. W. Whiteside, consulting engineer, Denver, Colo., was again chosen secretary-treasurer. Other officers elected at the Salt Lake City meeting were:

Vice-Presidents: R. C. Oliver, vice-president, Oliver Coal Co., Paonia, Colo.; Oscar Huber, president, Albuquerque & Cerillos Coal Co., Albuquerque, N. M.; Walter Wetzell, general superintendent, U. S. Fuel Co., Hiawatha, Utah; D. H. Pape, president, Sheridan-Wyoming Coal Co., Monarch, Wyo.

Executive Board Members: Thomas Allen, chief State coal-mine inspector, Denver, Colo.; Roy Williams, general superintendent, National Fuel Co., Lafayette, Colo.; L. C. White, vice-president, St. Louis, Rocky Mountain & Pacific Co., Raton, N. M.; Clarence Uhland, assistant superintendent, Gallup American Coal Co., Gamerco, N. M.; Walter Cochrane, mine superintendent, Royal Coal Co., Rolapp, Utah; George Jackson, mine foreman, Independent Coal & Coke Co., Kenilworth, Utah; Louis LaSalle, general superintendent, Colony Coal Co., Rock Springs, Wyo.; M. J. Grillos, assistant safety engineer, Union Pacific Coal Co., Rock Springs, Wyo.

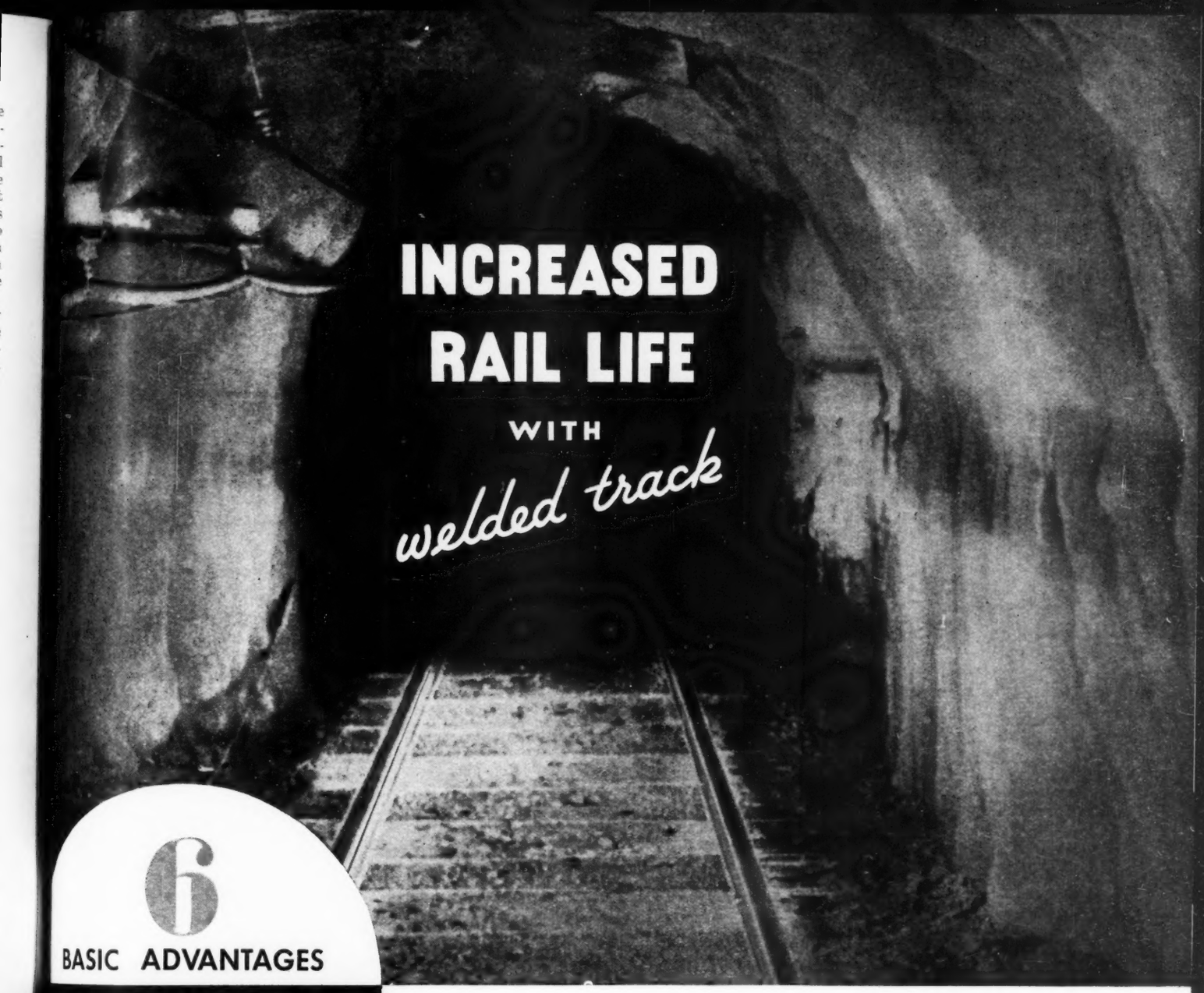
Permissable Plates Issued

Three approvals of permissible equipment were issued by the U. S. Bureau of Mines in June, as follows:

Goodman Manufacturing Co.: Type 260-B loader (redesigned); four motors, 50, 4, 1½ and 1½ hp.; 250 volts, d.c.; Approval 374; June 7.

Jeffrey Manufacturing Co.: Type 29-U Model 39 track-mounted mining machine; 50 and 25-hp. motors, 220 and 440 volts, a.c.; Approvals 375 and 375A; June 29.

Bright Star Battery Co.: Bright Star flashlight; Approval 607; June 24.



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ridges of permissible explosives inclosed around their outside circumference and throughout their full length by a sheathing with sodium bicarbonate as its principal ingredient. "When a cartridge of a permissible explosive is so sheathed," explained Mr. Wetzel, "the heat developed by the explosion of the powder decomposes the sheath, resulting in the liberation of a blanket of carbon dioxide and other inert materials between the gases produced by the explosive and any methane-dust-air mixture which may be in the immediate vicinity. In addition, there is a considerable absorption of heat which exists in the gases produced by the explosive." Official British tests indicate that "the application of sheathing allowed—without ignition—the firing of at least three times the weight of explosive that can be fired unsheathed."

Demonstrating how lightning is formed and discharged, Dr. H. T. Plumb, engineer, General Electric Co., stressed the necessity of having adequate grounds for lightning arresters. An arrester, he asserted, is no better than its ground and a poor arrester with a good ground is better than a good arrester with a poor ground. "Silent" underneath lightning does more harm to transmission lines than the more spectacular variety.

Accidents and Compensation

Three important problems confront industry and government agencies dealing with accidents and accident compensation, said O. F. McShane, State Industrial Commissioner for Utah. These are: (1) To make and enter a proper award when the right to compensation has been proved; (2) to reeducate and return to remunerative employment those who suffer a physical handicap due to industrial injury; (3) to prevent accidents. Compensation should be adequate to cover monetary remuneration for the time lost and for the best medical attention and care. But the law does not contemplate paying the wage earner for his entire loss because that would be "a temptation for many men to develop the habit of getting injured and to prolong disability periods because they would rather have a major portion of their wages and loaf than their full wage and work."

Rehabilitation should not be a matter of sympathy but should be based on the economic value to society of returning the injured man to suitable employment. Not all, it is true, can be rehabilitated—some because of the nature of their injuries, some because of mental limitations, some because of age. These, however, are questions for a skilled and sympathetic director of rehabilitation work to determine. That places may be found for such men not thus disqualified is proved by the policy at the Ford Highland Park plant, where one out of every three men at work has some serious disability.

Accident prevention, however, is the major problem. This calls for unity of action with safety-mindedness starting at the top. Few accidents today, according to Mr. McShane, can be directly charged to lack of safety appliances or faulty construction. A careful workman is still the greatest safety factor, and the biggest hope for reduction in accident frequency "is in the education of the workers themselves." There are several mental factors which, if not recognized and counteracted, will upset the best safety program. These are ignorance, inexperience, mental limitations, faulty attitude, excitability, inattention and lack of interest in the work.

During the nine years ended June 30, 1935, it required 271,157 man-hours of exposure to produce a fatal accident in Utah coal mines; 6,643,348 man-hours for a permanent total injury, 104,825 man-hours for a partial permanent injury and 4,668 man-hours of exposure for a temporary injury. During the next three years, the man-hours exposure record was: 503,280 per fatal accident; 15,098,415 hours for a permanent total; 111,840 for a permanent partial and 4,654 hours for a permanent injury. For fatalities on a man-hour exposure basis, Mr. McShane pointed out, this represented an improvement of 85.6 per cent; for permanent total injuries, 127.2 per cent; for permanent partials, 6.6 per cent. For temporary injuries, the two records were almost a stand-off.

Medical examinations, he said in answering questions from the floor, are to be approved when the purpose is to know the physical condition of the man and to see he is employed at a job suitable to his limitations. As a device to throw men on the industrial scrap heap, he condemned them. It is difficult, he added, to fix definite age limits because some men of 65 are much better than some others many years younger.

There is neither a single cause nor a single cure for accidents, stated R. R. Knill, safety engineer, Union Pacific Coal Co., in a paper read by M. J. Grillos, assistant safety engineer. No cure, however, will work "unless we have co-operation among the employees themselves and between the employees and the officials." Safety meetings—although not, in the author's opinion, the most effective way to produce this cooperation—have a very definite part in an accident-prevention program. Engineering, education and enforcement are essential to a successful program. Poor legislation, however, is bad, if not worse, than no legislation. Good legislation, he insisted, is generally the result of cooperative effort between officials and employees. Company rules and regulations, if framed on experience, also play a worth-while part.

No universal rule can be laid down for safety meetings. A type that works with one company or locality may fall flat elsewhere. Union Pacific experience with safety meetings, he continued, has been varied. Earlier meetings in different mining districts were not regularly scheduled and attendance "was only fair." Entertainment features boosted attendance for the social side of such gatherings, but added little to the safety side. Next sectional or occupational meetings were tried; some very good discussions developed, but even these meetings were not consistently well attended "and they could hardly be classed as successful."

Boosting Safety Meetings

During this period, said the author, various prizes were offered for safety work. These prizes were distributed at annual or semi-annual meetings and increased both interest and attendance for about three months before the award. It was then decided to break up some of the larger prizes and give them at monthly meetings, for the men only. To be eligible for a prize, a man must be either at the meeting or working. Meetings start promptly, seldom last more than an hour. The usual program is a one- or two-reel educational movie, discussion of all accidents of the preceding month and what may be done to prevent their recurrence, then a short safety talk by one of the company officials or an outside speaker and, finally, the drawings for the prizes. Attendance at this type of meeting has grown steadily. The presence of officials as well as workers convinces the latter that management is genuinely interested in safety. Consistently well-attended meetings also "break down the antagonism toward such gatherings and almost entirely eliminate the criticism of the men who do attend."

Cooperation of Utah operators in working for safety was highly praised by Jack Taylor, chief State coal-mine inspector. Utah, he said, had the first group of rock-dusted mines in the country and also took the lead in ventilation. From one of the blackest fatality records of the country in 1912, Utah has climbed in safety with only one fatality last year.

During the past decade, according to Walter H. Walsh, safety engineer, Southern Wyoming Coal Operators' Association, machinery has revolutionized the mining industry. This revolution makes job training imperative, but, unfortunately, "old rawhide methods" still largely prevail. The drive for job training and efficiency must come to the top. It is no longer possible to rely upon the skill of the older workers in doing this training because the average young man going

ALMOST A SAFETY DECALOG

1. Thou shalt rejoice in the knowledge of an unmaimed body and exercise great care to keep it so;

2. Thou shalt avoid all preventable accidents that thy days may be long upon the earth;

3. Thou shalt honor thy careful coworker, for by following his example the black camel of death will not kneel at thy gate;

4. Thou shalt keep thy mind on thy work that thy fingers may remain on thy hand;

5. Thou shalt not take a chance; to do so is mockery and places the value of zero upon thy life;

6. Thou shalt not disregard warning signals; to do so invites injury, pain, privation and want, with its attendants;

7. Thou shalt not take short-cuts over dangerous places;

8. Thou shalt not engage in "horseplay"; serious results follow therefrom and compensation balm in such cases is withheld;

9. Thou shalt not rest or lean against railings, for death to Utah workmen has resulted therefrom;

10. Thou shalt not fail to wear goggles while engaged in any work where there is danger of chips or splashes entering the eye;

11. Thou shalt not fail to report promptly all accidents for by so doing claims which would be promptly and properly settled are held up.

—Admonitions to workers delivered by O. F. McShane, Utah Industrial Commission at Rocky Mountain Coal Mining Institute meeting.

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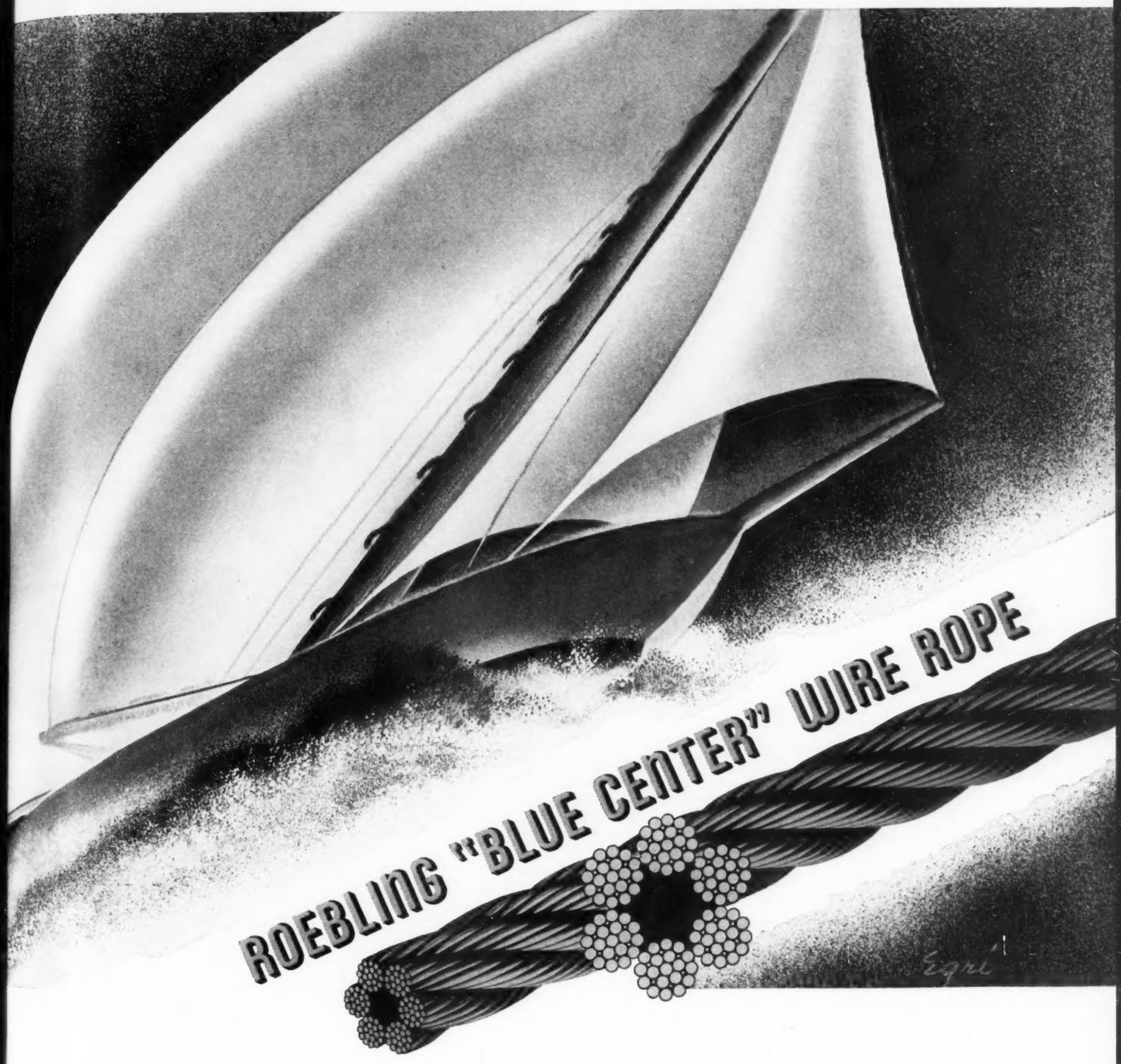

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into the mines today has a better educational background than his father.

Before the foreman can act as instructor he himself needs to be trained; otherwise the novice will receive as many different ideas on how to do certain jobs as there are foremen over him. Results from group lectures and demonstrations were rated as problematical by Mr. Walsh, who recommended that the training be given in small informal groups. The ability to supervise is dependent upon the ability to teach. All orders given the worker should cover what to do, where to do it, when, how, why and who is to do it. Machine training should embrace instruction on the construction of the equipment to be handled, its parts, controls, operation, safety factors and maintenance.

Accident-prevention work, as George B. Jackson, mine foreman, Independent Coal & Coke Co., emphasized, must really precede a possible accident to prevent its occurrence. Future operations, therefore, should be analyzed and projected far ahead of the actual work. Mining on a full retreat system means safer work and a higher percentage of extraction. Every worker should be given 100 per cent first-aid training. Competition in local, State and national safety meets should be encouraged. Each operation should have an established code of standards complete in every detail. Management is primarily responsible for initiating the work epitomized in these recommendations, but the desired results cannot be achieved unless every individual worker is stamped with the idea that a mine is only as safe as the men who work in it.

How Miner Views Safety

How the men in the mine are impressed by the actions of the officials in the drive for safety and efficient operation was related by Thomas R. Biggs, fireboss, Utah Fuel Co. He drew his observations—some of which were not flattering to management—from his experiences in a number of mines. The burden of his safety talk was "practice what you preach." How can management expect the men to be safe and careful workers, he asked, if they see foremen, superintendents and still higher officials violate the rules management itself has laid down? Poor housekeeping, he said, promotes inefficiency. Supply-handling systems should be studied so that breakdowns and delays through failure to have parts on hand may be eliminated.

How the world's deepest core drill, down over 10,700 ft. in the South African gold fields, was handled was described by John H. Emrick, Denver manager, Sullivan Machinery Co. Mechanization, stated D. F. McElhattan, sales representative, Mine Safety Appliances Co., is a challenge to manufacturers to meet changing conditions. Turning to mine illumination and describing the features of the Edison Model K lamp, Mr. McElhattan, showed a sound movie which featured studies of the relative efficiencies of electric and carbide lamps made by the Electrical Testing Laboratories. Another movie—in sound and technicolor—on "Steel—Man's Servant" was presented by the American Steel & Wire Co. A paper on "Timber Recovery in Mechanical Loading," by George A. Brown, superintendent, Union Pacific Coal Co., Superior, Wyo., originally presented at the American Mining Congress (*Coal Age*, June, 1939, p. 56), was read by Robert V. Hotchkiss, mine foreman.

Benedict Shubart, Shubart & Schloss, for many years secretary of the institute, was honored for his years of service to the organization by being elected a life member. Mr. Shubart was unable to attend the meeting because of serious illness.

Work of Setting Minimum Prices Proceeds As New Division Is Set Up

WASHINGTON, D. C., July—Despite the demise of the Coal Commission, which passed out on June 30, the work of setting minimum prices for bituminous coal is proceeding unremittingly. Hearings on proposed prices for Districts 1–8 and 9–15 was set to begin July 24 and Aug. 7, respectively, in the North Interior Building. When these are completed, all areas will have been covered, hearings for the Rocky Mountain and Pacific Coast districts having already been held. Secretary of the Interior Ickes has issued an order continuing in effect all regulations, orders, instructions, forms and notices adopted by the Commission and has placed administration of the Bituminous Coal Act in charge of the department's Bituminous Coal Division through the Division's Director, Howard A. Gray, assisted by Dan H. Wheeler, Assistant Director.

Harris & Ewing

Howard A. Gray

Mr. Gray has been connected with the Public Works Administration since shortly after its establishment, first in the Inspection Division, then as Director of the Housing Division, and finally as Assistant Administrator of PWA. He also has had extensive experience in private business—in the field of fire insurance and later in an executive capacity with steel and machinery companies. Mr. Wheeler has for the last six years been attorney in charge of administrative matters for PWA and director of the Projects and Statistics Division.

Percy Tetlow, formerly chairman of the Commission, has been named by Secretary Ickes as technical adviser to Director Gray. Mr. Tetlow's connection with the coal industry covers 51 years, beginning at the age of 12, when he entered the mines as a pick miner. He also has been an official of the United Mine Workers, member of the Ohio Legislature, and finally a member of the Coal Commissions of 1935 and 1937, presiding over the numerous hearings during the last year and being intimately concerned with policies and technical steps leading to the determination of costs of producing coal as a base for prices, and with the formulation of proposed prices schedules.

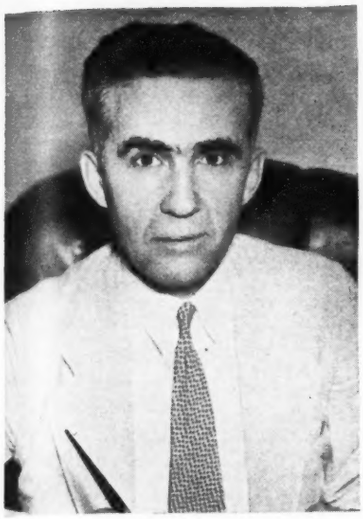
Designees to conduct the final hearings are Thurlow G. Lewis, presiding examiner, and Examiners Charles O. Fowler and Samuel Jaffee, named by the Division Director on July 12. The designation order also gave notice that parties dissatisfied with any proposed minimum prices were privileged to file protests setting forth the interest of the protestants and concise statements of matters in dispute.

Functions previously vested in the office of former Consumers' Counsel John Carson will be handled by a newly created Consumers' Counsel Division in the solicitor's office of the Interior Department, under Nathan R. Margold, solicitor. Frederic L. Kirgis, first assistant solicitor, will direct the new division.

Commission Cleared Deck

Before going out of existence on June 30 the Commission had cleared its calendar of all major pending matters so that it could hand over complete minimum price schedules, ready for final hearing and promulgation, when administration of the Coal Act passed over to the Interior Department. In relinquishing his duties Chairman Tetlow stated: "I am certain that our work to date is sound and that we have built a strong base for practical, enduring minimum prices and marketing rules, which will protect the bituminous-coal industry from the evils which have kept it in a chaotic condition for nearly a quarter of a century." The job of determining costs of production and preparing the coordinated price schedules, he added, required a tremendous amount of statistical information, covering "the countless transactions which made up the costs for the nation's bituminous mines and the information necessary to classify as to kind, quality or size of the numerous coals produced by the mines of each of the approximately 11,600 code members."

Provisional approval as a marketing agency was granted by the Commission on June 29 to the Southwest Coal Co., Kansas City, Mo. The agency's petition said it would be exclusive agent for the sale of all coal produced by sixteen companies operating in Kansas and Missouri, except



Dan H. Wheeler

that used for operation of the producers' mines, sold for use by their employees, or to the railroads. The companies produced about 3,800,000 tons in 1936. Authorization also was given to the Western Pennsylvania Coal Corporation, Pittsburgh, a marketing agency, for a change in the form of contract used by it which would permit it to sell coal delivered by trucks from the mine or from truck-loading facilities adjacent.

In an order issued June 28, the Commission announced that it had determined that all coal produced in North and South Dakota (designated in the Bituminous Act as District 21, Minimum Price Area 8) is lignitic and therefore not subject to the provisions of the act.

Jonas Waffle was elevated to chairmanship of the Indiana Coal Producers' Board on June 28, succeeding Hugh Lee, who was made vice-chairman. Frank McConnell, who resigned from the board, was replaced by Thomas Moore. Employee members of the 23 district boards have all been renamed, the Commission having issued an order designating the United Mine Workers as representing the preponderant number of workers in all districts.

The U. S. Circuit Court of Appeals for the Eighth District, sitting at St. Louis, Mo., delivered an opinion on June 19 affirming a Commission order that coal produced by the Sunshine Anthracite Coal Co., Fort Smith, Ark., is subject to the Guffey act.

A resolution favoring repeal of the 1c. a ton tax on bituminous coal imposed by the Guffey act was adopted on June 28 by the Colorado and New Mexico Coal Operators' Association, said to represent 90 per cent of the total production in those States.

Mine Blast Kills 28

Twenty-eight miners were killed in an explosion in the Duvin mine of the Ruckman Coal Co., Providence, Ky., on July 14. The blast, which occurred about 1,200 ft. from the shaft, 250 ft. below the surface, is believed to have been due to the ignition of coal dust. Ten other miners of the 38 working at the time were rescued.

Gray to Enforce Coal Act Vigorously; Amend the Law, Urges Allen

By PAUL WOOTON

Washington Correspondent, Coal Age

AFTER a personal conference with Howard A. Gray, the director of the new Bituminous Coal Division of the Interior Department, the writer reaches these conclusions: Mr. Gray is determined to go forward vigorously with the provisions of the act. He believes it should be strictly enforced. He thinks it presents a great opportunity for the coal industry to obtain living prices. He is certain that a bankrupt industry is a liability to all concerned. Everyone recognizes, he is convinced, that price cutting must stop. The Guffey act makes that possible. Consumers must learn, Mr. Gray believes, that there is immoral buying just as well as there is immoral selling.

Mr. Gray is going to do everything in his power to push the work forward with all the dispatch possible. He thinks the act is workable, but that it will require wholehearted cooperation from the industry to make it work. He thinks it is a challenge to the industry to do its part. Failure is certain, he feels, if the industry tries to put all the responsibility in the lap of bureaucracy. The government can do its part but can do no more than the industry will help it do. Mr. Gray is inviting cooperation and help from the industry.

There is reason to believe that Mr. Gray regards with sympathy the suggestion that marketing agencies should be developed, not as a substitute for minimum prices but as a means of reinforcing the purposes of the act.

The National Coal Association is anxious to see the new administration undertake the study of marketing quotas, as is provided in Sec. 14 of the act, as well as the technical study of new uses.

Despite Mr. Gray's assurances that he is going to press the work, it is recognized that there is much in the situation beyond his control that easily could make for delay. Some interests are preparing to question the legality of the transfer. This endangers the whole experiment, some think. There are predictions that the courts will throw out the new prices just as they did the first ones announced. A battle over the consumers' counsel is certain.

To have placed the burden of doing the job on the shoulders of a man who knows nothing about coal is regarded by various observers as all that is needed to jeopardize the plan. The transfer, they feel, has created a lawyers' paradise. Validity of any prices fixed is certain to be challenged, as will the relationship between prices, some anticipate.

Change in the functioning of the Consumers' Counsel raises the point that States and municipalities, which are large consumers of coal, have independent representation and have an opportunity to get fair prices or better than fair prices to the disadvantage of other consumers. Once prices are promulgated, no consumer can intervene except through the Consumers' Counsel. Railroads do have the right to appeal, but must convince Harold L. Ickes, the Secretary of the Interior, that his man Gray is wrong. It also is hard to conceive Mr. Ickes' solicitors taking Mr. Ickes and Mr. Gray into court. The point made is that, in effect, the same agency that fixed the prices would represent the consumer who objects to them.

It is claimed that the inclusion of the coal commission in the reorganization plan was eleventh-hour action put over cleverly by those who are working to nullify the Guffey act.

Some estimate that it will take until November to complete the hearings and issue the final prices.

Coming Meetings

- American Coal Distributors' Association: annual meeting, Sept. 21–23, French Lick Springs, Ind.
- Joint meeting of Coal Division of American Institute of Mining and Metallurgical Engineers and Fuels Division of American Society of Mechanical Engineers: Oct. 5–7, Columbus, Ohio.
- Lehigh Valley Section of American Institute of Electrical Engineers: Oct. 11–13, Hotel Casey, Scranton, Pa.
- National Safety Council: 28th safety congress, Oct. 16–20, Atlantic City, N. J.
- National Coal Association: Seventeenth convention, Oct. 23–25, Roosevelt Hotel, New York City.
- Illinois Mining Institute: 47th annual meeting, Nov. 10, Hotel Abraham Lincoln, Springfield, Ill.

Allen Still Sees Crisis

Elimination of the Bituminous Coal Commission and transfer of its functions to the Interior Department are far from solving the difficulties of the bituminous coal industry, in the opinion of Representative Robert G. Allen of Pennsylvania, author of the bill to repeal the Guffey act. According to Mr. Allen, "there is no sicker industry in America than that pertaining to the mining and distribution of bituminous coal; nor is any other industry more nearly indispensable to the general health and economic welfare. A crisis exists in this basic industry which must be met by immediate, well-considered action.

"For eleven years the bituminous industry has suffered an uninterrupted succession of losses. In 1928 the aggregate loss was twenty-eight million dollars; by 1932 it had increased to fifty-one million dollars. It was at this point that the coal operators sought refuge in fed-

eral regulation. Since June, 1933, the industry has suffered from ill-advised experiments in federal regulation. The first of these was the NRA Bituminous Coal Code. This code was a price-fixing device which never worked and, fortunately, was invalidated by the Supreme Court in May, 1935. The only permanent effects of the code were deleterious. Rates of wages for mine workers were advanced and a seven-hour day was established. These factors, although humanitarian in purpose, increased the cost of coal production and begot further demoralization.

"The second attempt at federal regulation was embodied in the Bituminous Coal Conservation Act of 1935. Its title was misleading, for it was exclusively a price-fixing formula. The act provided for appointment of a commission of five with elaborate and expensive machinery for administration of the act. The Supreme Court also invalidated this act, because the price-fixing provisions were inextricably bound with the labor provisions, thereby infringing upon the rights of individuals.

"By this time, far-sighted operators violently opposed further federal regimentation, but a new Bituminous Coal Act was passed by Congress in April, 1937. The price-fixing devices were retained, the cost of administration was increased by appointment of two additional commissioners and by the installation of an even more elaborate and expensive administrative machinery.

"During the first months of the life of the new Commission, politics hampered its efficiency. The dispensation of jobs, accompanied by patronage quarrels among Senators from coal States, retarded progress by the Commission. After two years of wrestling with the problems of the industry, the Commission's accomplishments amounted to exactly nothing. This failure resulted from inefficiency of the Commission itself and the utter impracticability of the act which they were charged to administer.

"The Commission did establish a schedule of prices in December, 1937, under arbitrary and allegedly illegal methods of procedure. Protests by persons affected who were not given adequate hearings or the opportunity to examine evidence followed by litigation in the courts compelled the Commission to revoke these prices. The bewilderment which exists among the Commissioners can be graphically portrayed when we understand that 500,000 different price schedules on coal exist in the Appalachian area alone. Even if minimum sale prices of coal are eventually established under existing law, constant litigation will result, with concomitant chaos and confusion.

"In the meantime the industry operates under severe handicaps imposed upon it by the act. It is estimated that the industry lost in excess of one hundred million dollars in 1938. It may be said without fear of contradiction that this vital industry is in the most demoralized condition in its entire history. The industry has been obliged to pay the cost of the Bituminous Coal Commission, the money raised through a federal tax of 1 cent per ton on each ton of coal mined. This tax amounts to several million dollars a year. Direct assessments against the operators also are made to support the district boards. These assessments aggregate more than the federal tax itself. Each mining company must bear the cost of preparing elaborate statistical reports and attending countless committee meetings and conferences. It must be borne in mind that no other industry in America is obliged to support a federal regulatory board.

"A second onerous provision of the existing coal act limits the term of contracts for the sale of coal to 30 days. The result has been to put contract coal on a spot-price basis, which places the entire industry on the auction block. The effect of this regulation has been disastrous. The cost of selling a new contract each 30 days is trivial compared with disrupted production schedules and general

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Sponsored by the Pocahontas Electrical and Mechanical Institute, the fifth annual meeting with technical sessions and manufacturers' exhibits will be held at the Norfolk & Western Freight Terminal, Aug. 17-19, 1939, in Bluefield, W. Va. Officers of the institute are, T. A. Mitchell, president; E. E. Rich, vice-president; S. S. Cooper, secretary; B. B. Housman, treasurer. R. C. Luther is serving as general chairman; J. H. Bowen, vice-chairman, and B. B. Housman, director of exhibits.

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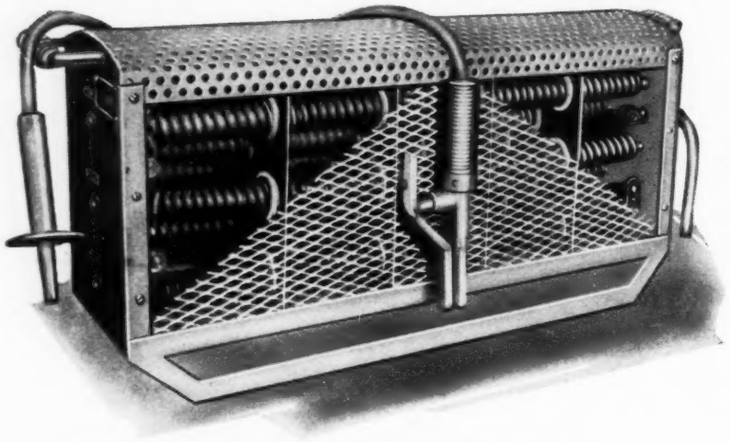

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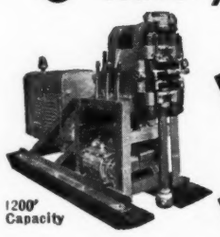

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uncertainty. In addition to these handicaps former large consumers of coal have switched to substitutes more stable as to price range. If the production and distribution of coal is to be regimented by bureaucratic edict, similar applications must be made against natural gas, fuel oil, and hydro-generated power.

"A perfectly ridiculous spectacle presents itself when we watch the government vainly attempting to aid the coal industry on the one hand while on the other hand developing huge hydro-electric projects which will eventually compete with coal and capture a large portion of the consumer market. The government is destroying the coal industry while its competitors run wild with unfettered freedom. In Chicago several large industries contracted for natural gas at 7½c per thousand cubic feet. This same gas was sold to domestic consumers for $1.84 per thousand cubic feet. If coal dealers in Chicago could apply these same sales methods, industrial coal would be sold at $1.57 per ton and domestic coal at $36.80 per ton.

"To add to the general dilemma which obtains in the bituminous coal industry today, there is the possibility that the Department of the Interior will establish minimum prices. Aside from the general confusion which will reign, the wholesale and retail prices of coal will be substantially increased, adding approximately $100,000,000 per year to the burdens of the consuming public. These increased prices will, of course, drive more consumers into the open arms of the producers of natural gas and fuel oil. The inevitable result will be less coal mined, more miners out of work, and continued heavy losses in an industry where even higher unit prices cannot offset the increased costs which attend curtailed production.

"This horrendous example of government control of private industry should be a warning to American citizens. It has been a colossal failure. It has been a contradiction to the American system of free enterprise. It has violated every tradition on which the economic structure of this country was founded. The bituminous coal industry refuses to be regimented any longer. It rightfully demands the privilege of regulating its own affairs in the interest of miners, operators and the consuming public."

Coal Utilization to Feature Fuel Engineers' Meeting

Coal utilization will be the central theme of the third annual joint meeting of the Fuels Division of the American Society of Mechanical Engineers and the Coal Division of the American Institute of Mining and Metallurgical Engineers, to be held Oct. 5-7 at the Deshler-Wallick Hotel, Columbus, Ohio. The program has been completed by the committee composed of H. O. Croft, State University of Iowa; H. F. Hebley, Commercial Testing & Engineering Co.; H. E. Nold, Ohio State University; J. E. Tobey, Appalachian Coals, Inc., and R. A. Sherman, Battelle Memorial Institute.

One session is to be devoted to the utilization characteristics of coal as related to mining methods, with separate consideration of underground and strip-

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mining operation. Coal utilization in steam generation will be discussed in a second session. Topics scheduled for this group include "Coordination of Fuel Engineering From Mine to Consumer," "A Proposed Code for Testing Coal" and "Recent Developments in Equipment for Burning Anthracite Coal."

The future design of the coal-burning locomotive and advances in coal-burning equipment in ships on the Great Lakes will be considered in a third symposium. The fourth and concluding technical session will include papers on firing open-hearth steel furnaces with pulverized coal, the viscosity of coal-ash slags, and photography in boiler furnaces. An address on the relation of the bituminous-coal and manufactured-gas industries is planned for one of the luncheon sessions.

Visits to the Jeffrey Manufacturing Co., Battelle Memorial Institute, and the municipa' light plant will occupy the morning of Oct. 7.

Congress Agrees on Cut in TVA Bond Issue

A deadlock between the Senate and House at Washington over authorizing the Tennessee Valley Authority to issue bonds for purchase of properties of the Tennessee Electric Power Co.'s and other privately owned utility companies was ended on July 11 when the conferees agreed on a compromise, which was passed by Congress three days later. The conferees reduced the bond-issuing authority from $100,000,000, as proposed by the Senate, to $61,500,000, as voted by the House (*Coal Age*, July, p. 69).

Although the language of the House version relating to restrictions upon TVA was deleted from the conference report, it earmarks the money funds to be derived from the bonds, and to that extent restricts the activities of TVA. Representative May of Kentucky, chairman of the House conferees, who offered the compromise, predicted that the conference report, if adopted, would stop the trend toward what he termed "State socialism."

Sales of Mechanical Stokers Register Advance

Sales of mechanical stokers in the United States during May last totaled 5,238, according to statistics furnished the U. S. Bureau of the Census by 101 manufacturers (Class 1, 54; Class 2, 26; Class 3, 30; Class 4, 30; Class 5, 13). This compares with sales of 3,591 units in the preceding month and 4,969 in May, 1938. Sales by classes in May last were: residential (under 61 lb. of coal per hour), 4,574 (bituminous, 4,076; anthracite, 498); small apartment-house and small commercial heating jobs (61 to 100 lb. per hour), 249; apartment-house and general small commercial heating jobs (101 to 300 lb. per hour), 200; large commercial and small high-pressure steam plants (301 to 1,200 lb. per hour), 148; high-pressure industrial steam plants (more than 1,200 lb. per hour), 67.

Charles H. Lambur, Jr.

Midwestern Engineer Joins Coal Age Staff

Effective Aug. 1, Charles H. Lambur, Jr., assistant mining engineer, Sahara Coal Co., Harrisburg, Ill., becomes a member of the editorial staff of *Coal Age* with headquarters in New York City. Mr. Lambur, who was born in St. Louis, Mo., in 1910, was graduated from the mining department of the Missouri School of Mines and Metallurgy at Rolla in 1933 with a B.S. degree.

One of his first assignments was the preparation of a mineralogical report on properties controlled by a California oil company. Upon completion of this work, he returned to Missouri as a project engineer with the State Highway Department. In 1934 he resigned to join the staff of the mining engineering department of the Philadelphia & Reading Coal & Iron Co. Later he organized a partnership for the exploration and development of quicksilver properties in Texas. Returning to the coal industry, he became affiliated with the engineering department of the Sahara Coal Co. in the opening and developing of its new stripping and slope mines in the Southern Illinois field.

Obituary

W. J. HEATHERMAN, mining engineer, who served as chief of the West Virginia State Department of Mines under Governor John J. Cornwell, died July 3 in a Charleston (W. Va.) hospital of coronary thrombosis.

LLEWELLYN RICHARDS, 53, editor of the *Anthracite Tri-District News*, died suddenly July 7 in Hazelton (Pa.) State Hospital. During his extensive newspaper experience he became closely associated with John L. Lewis and Thomas Kennedy, United Mine Workers officials, becoming editor of the miners' organ in 1925.

GEORGE W. SOLOMON, 59, president and general manager of Panther Creek Mines, Inc., Springfield, Ill., died June 15 in Hollywood (Calif.) Hospital after a long

illness. Started in 1918 with less than 100 men, the company had expanded to five operations with more than a thousand employees when operating full time.

Denies Injunction Against Harlan Union Pacts

Special Judge J. B. Hannah, in Harlan Circuit Court, refused on July 7 to grant an injunction sought by non-union miners to prohibit Harlan and Bell County (Kentucky) coal mines from signing "union shop" contracts with the United Mine Workers. In their petition, filed in May, the plaintiffs contended the signing of union shop contracts was in violation of the Wagner Labor Act and of the "due process" clause of the Constitution, since they would lose their jobs unless they joined the union. The court said in his opinion that the plaintiffs did not have "any actionable interest in the case."

Personal Notes

EDWARD P. ARTHUR, of Cripple Creek, has been appointed State Commissioner of Mines of Colorado, vice JOHN T. JOYCE, retired. Mr. Arthur studied at the School of Mines at Golden and has served several terms as State Senator.

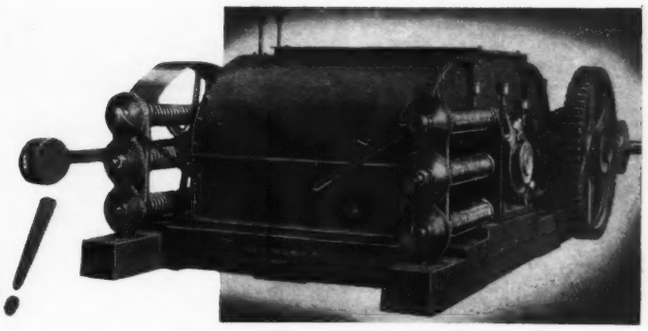
RAY ELLIS has been appointed mine-rescue director for Logan and Mingo counties, West Virginia, according to an announcement by N. P. Rhinehart director of the State Department of Mines. Connected with the department for several years, Mr. Ellis replaces H. Prentice Farley, now chief game protector.

P. C. GRANEY, who has served as secretary-treasurer of the Winding Gulf Operators' Association for the last ten years, has resigned as secretary, but will continue as treasurer. HAL M. SCOTT, who has been assistant secretary for several years, succeeds Mr. Graney as secretary.

R. L. IRELAND, JR., president, Hanna Coal Co., has been reelected president of the Ohio Coal Association. Other officers named are: vice-president, E. H. DAVIS, chairman of the board, New York Coal Co.; executive vice-president, EZRA VAN HORN; secretary-treasurer, D. F. HURD; assistant secretary-treasurer, E. H. MILLER. Directors include W. P. CAYTON, S. A. COTTINGHAM, S. B. JOHNSON, GEORGE M. JONES JR., J. H. MILES, J. C. NELMS, W. L. ROBISON, R. W. RUTLEDGE, H. G. SCHMIDT, G. K. SMITH, WHITNEY WARNER and E. S. WILLARD.

CHARLES E. LAWALL was named president of West Virginia University, Morgantown, on July 1. He was appointed acting president about a year ago, when Dr. Chauncey S. Boucher resigned. Mr. Lawall was graduated in mining engineering from Lehigh in 1914 and has headed the School of Mines at West Virginia for a number of years.

JOHN J. LINCOLN, vice-president, Crozer Coal & Coke Co., has been reelected president of the Pocahontas Operators' Association. Other officers renamed are: vice-president, O. L. ALEXANDER, president, Pocahontas Fuel Co., and treasurer, H. F. WARDEN, general manager, American Coal



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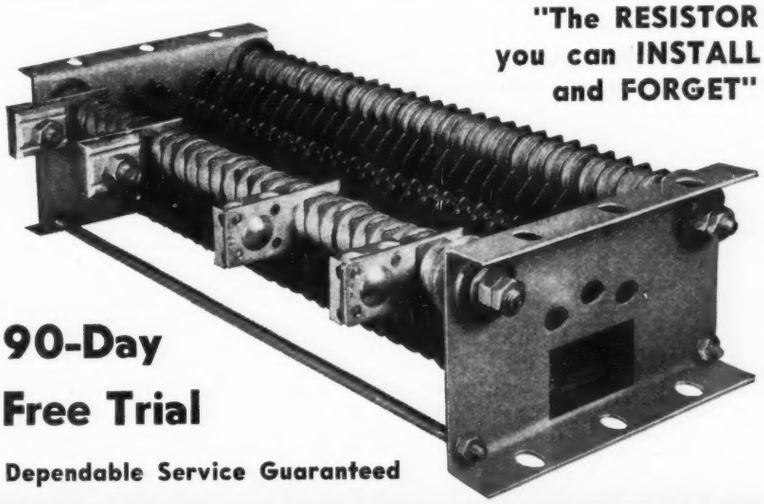

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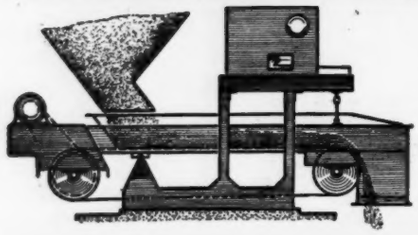

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Departmental Advertising Staff
COAL AGE, 330 W. 42nd St., N. Y.

Co. of Allegany County. Newly elected members of the executive committee are: L. EPPERLY, president, Winding Gulf Collieries; H. C. FAUST, general manager, United Pocahontas Coal Co.; W. A. RICHARDS, president, Pemberton Coal & Coke Co., and R. E. SALVATI, vice-president, Pond Creek Pocahontas Co.

LEE LONG, vice-president, Clinchfield Coal Corporation, was named president of Southwestern Virginia, Inc., at the annual meeting of the regional chamber of commerce.

CHARLES A. OWEN, president, Imperial Coal Corporation, has been appointed chairman of the general convention committee to handle the program for the meeting of the National Coal Association to be held Oct. 23–25 at the Roosevelt Hotel, New York City.

P. R. PAULICK, formerly mechanization engineer for the Princeton Mining Co., Princeton, Ind., has been appointed production engineer by the North American Coal Corporation, with mines in Pennsylvania and Ohio. Also at one time associated with the Hanna Coal Co., Mr. Paulick has for the last thirteen years specialized in mine mechanization in Pennsylvania, Ohio, Indiana, Illinois and West Virginia.

DONALD W. SCOTT, research engineer, has been added to the technical staff of Battelle Memorial Institute, Columbus, Ohio. He has been assigned to the concentration division, which works on developing and improving concentration methods and equipment for coals, ores and other industrial materials. A graduate of the University of Missouri, Mr. Scott recently received an M. S. degree in mining engineering from the University of Alabama, where he held a U. S. Bureau of Mines fellowship.

Illinois Mine Bills Signed

The Johnson bill providing for the expenditure of $300,000 for experiments at the University of Illinois to develop a process to make Illinois coal smokeless (*Coal Age*, May, p. 72; July, p. 92) was signed on July 5 and made a law by Governor Henry Horner.

Another measure receiving the executive's signature was one to re-create a mining investigating commission to study the methods and conditions of mining in Illinois with special reference to the safety of human life and property and the conservation of coal deposits. The commission will be composed of nine members—three operators, three miners and three persons not identified with mining.

C. F. Richardson Passes

Charles F. Richardson, 77, president of the West Kentucky Coal Co., a subsidiary of the North American Co., died July 17 in St. Luke's Hospital, St. Louis, Mo., after a week's illness. Starting his career in the railroad industry, Mr. Richardson became associated with coal interests in 1911, when he joined the West

Charles F. Richardson

Kentucky company as vice-president. He became president in 1916. For the last 20 years he divided his time between Sturgis, Ky., headquarters of the company, and St. Louis, where he made his home and also had an office. He was chairman of the traffic committee of the West Kentucky Coal Bureau, a director of the National Coal Association, member of District 9 Bituminous Coal Producers' Board, and was a vice-president and director of the Mississippi Valley Association.

Trade Literature

BLAST CLEANING MACHINE—Pangborn Corporation, Hagerstown, Md. Bulletin 211 describes the mechanical operation of Rotoblast cleaning tables, giving general specifications, floor plans, ventilating and motor requirements.

IRON PIPE—Republic Steel Corporation, Cleveland, Ohio. Form Adv. 333, entitled "Toncan Iron Pipe for Tough Service," covers the electric-weld process of manufacture; rust and corrosion resistance; recommended applications; details of various tests; physical properties; threading procedure; welding; sizes and weights; outstanding installations and service records in specific fields; how to specify and order, and other information.

PUMPS—Pomona Pump Co., Pomona, Calif. Bulletin No. 30 describes a new size Little Chief unit for plant owners and operators hitherto unable to obtain pumping equipment exactly suited to their needs.

SHAFT COUPLINGS—Morse Chain Co., Ithaca, N. Y. Bulletin 57 gives complete engineering data, installation and operating information, and recommended applications for the entire Morse flexible coupling line—silent chain couplings, roller chain couplings, Morflex couplings and universal drive shafts.

STRIP-PIT EQUIPMENT — Caterpillar Tractor Co., Peoria, Ill. Bulletin Form No. 5459 points out features of the No. 112 motor grader, said to be a versatile machine offered with either diesel or

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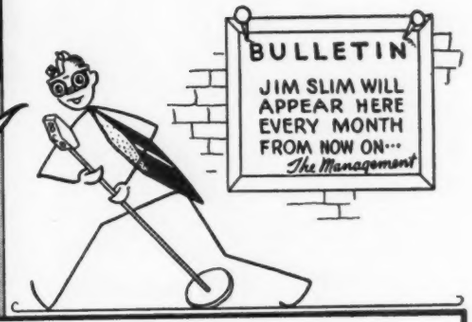

* "... and believe me, the Bowdil people have picked themselves a honey of a spokesman! Being built thin, like their solid steel cutter bar, I can speak with real authority on the advantages of its kind of construction over slower, bulkier, less economical equipment. Next month, I'll start giving you examples of what I mean, but if you can't wait that long (and I wouldn't blame you) just write to The Bowdil Company, Canton, Ohio, and they'll send you details pronto."

Jim Slim

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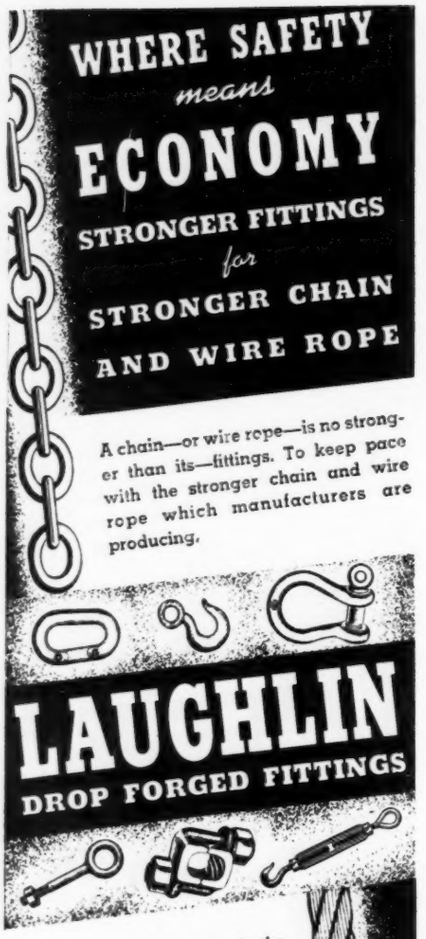
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STEELS—Joseph T. Ryerson & Son, Inc., Chicago. Folder contains compact physical properties chart giving tensile strength, yield point, elongation, reduction of area, hardness, and other physical properties of nearly 50 different types of steels.

SWITCHBOARDS—Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa. Descriptive Data 31-133 describes small-plant and industrial a.c. switchboards, with knife switches and fuses, adaptable to small generating plants, lighting service, industrial and mining applications.

WELDER—Lincoln Electric Co., Cleveland, Ohio. Welder Specification Bulletin No. 314-A tells outstanding features of 150-amp. "Shield-Arc Junior" unit with self-indicating dual continuous control.

Mine Accident Fatality Rate Shows Slight Decline

Accidents at coal mines in the United States caused the deaths of 27 bituminous and 19 anthracite miners in May last, according to reports furnished the U. S. Bureau of Mines by State mine inspectors. With a production of 17,880,000 tons, the death rate among bituminous miners was 1.51 per million tons, compared with 2.20 in the corresponding month of last year.

The anthracite fatality rate in May last was 3.75, based on an output of 5,071,000 tons, against 2.82 in May, 1938.

For the two industries combined, the death rate in May last was 2.00, compared with 2.31 in the fifth month a year ago.

Fatalities during May last, by causes and States, as well as comparable rates for the first five months of 1938 and 1939, are shown below:

UNITED STATES COAL-MINE FATALITIES IN MAY, 1939, BY CAUSES AND STATES

State	Underground: Falls of roof	Falls of face	Haulage	Explosives	Electricity	Machinery	Other causes	Total underground	Open-Cut and Surface: Shaft	Mine cars	Falls of persons	Electricity	Other causes	Total surface	Grand total
Alabama	2	..	..	..	..	..	..	2	..	..	..	..	..	..	2
Illinois	..	1	..	..	1	..	..	2	..	..	..	..	..	..	2
Indiana	..	..	..	..	1	..	..	1	..	..	..	..	..	..	1
Kentucky	2	..	..	..	..	1	..	3	..	..	..	..	..	..	3
Ohio	2	..	..	..	..	..	..	2	..	..	..	..	..	..	2
Pennsylvania (bit.)	5	..	..	..	..	..	..	5	..	..	..	..	..	..	5
West Virginia	9	..	1	..	..	1	..	11	..	..	..	..	..	..	11
Wyoming	..	..	..	..	..	..	..	..	..	1	..	..	..	1	1
Total (bituminous)	20	1	1	..	2	2	..	26	..	1	..	..	..	1	27
Pennsylvania (anthracite)	7	2	..	2	..	..	2	13	2	..	2	1	1	4	19
Grand Total	27	3	1	2	2	2	2	39	2	1	2	1	1	5	46

FATALITIES AND DEATH RATES AT UNITED STATES COAL MINES, BY CAUSES*

January–May, 1938 and 1939

Cause	Bituminous: Number Killed 1938	1939	Killed per Million Tons 1938	1939	Anthracite: Number Killed 1938	1939	Killed per Million Tons 1938	1939	Total: Number Killed 1938	1939	Killed per Million Tons 1938	1939
Underground:												
Falls of roof and coal	181	151	1.413	1.132	63	57	3.188	2.474	244	208	1.650	1.330
Haulage	54	43	.421	.322	12	8	.607	.347	66	51	.446	.326
Gas or dust explosions:												
Local	10	2	.078	.015	1	...	.051	.....	11	2	.074	.013
Major	60	...	.468	.....	8	...	.405	.....	68	...	.460	.....
Explosives	7	5	.055	.038	5	10	.253	.434	12	15	.081	.096
Electricity	16	16	.125	.120	1	1	.051	.043	17	17	.115	.109
Machinery	10	7	.078	.052	...	...	.....	.....	10	7	.068	.045
Shaft	2	2	.015	.015	2	4	.101	.174	4	6	.027	.038
Miscellaneous	6	5	.047	.038	5	7	.253	.304	11	12	.074	.076
Stripping or opencut	1	2	.008	.015	8	2	.405	.087	9	4	.061	.026
Surface	16	8	.125	.060	2	9	.101	.391	18	17	.122	.109
Total	363	241	2.833	1.807	107	98	5.415	4.254	470	339	3.178	2.168

* All figures subject to revision.

LETTERS
To The Editor

Horizontal Pressures Crush Roof Strata

One problem that has caused an endless amount of worry to mining men is the crushing and falling of the roof strata over advanced entries in development work. Quite frequently this trouble is experienced in one entry only of a set of entries and usually in the entry that is in advance of the other entries. It has been the general practice to assume that the pressure that was causing the roof to break was produced by gas or water or a combination of both. In most instances neither of these elements is responsible for the damage.

It is a well-known fact that in the formation of the earth's crust, horizontal pressures (not due to the weight of overlying surface) of tremendous proportions were created in the various strata. Many of these stresses have been released in various ways. The most familiar to our knowledge are the upheavals that formed our mountains. These eruptions occurred only where the pressure was strong enough to lift the overlying stratum.

These eruptions released the major stresses in the rock over large areas adjoining these disturbances.

However, over the greater portion of the earth's crust there still are horibontal stresses of gigantic proportions. However, they are not of sufficient force to disturb the equilibrium of the strata so long as the overlying and underlying strata are not removed.

When the supporting element is removed from under the roof in the operation of excavating entries, then the horizontal forces either squeeze the roof stratum together and cause it to bulge like a piece of soft rubber squeezed between the thumb and finger, or the roof will sag in the middle of the entry, causing the stratum to bend. In either case the roof stratum will likely crush and fall as the material in the roof structure has a very low elastic element.

The crushing of the stratum over one entry allows the strata on either side to move toward this entry. This movement may be only a small fraction of an inch, but it will be sufficient to relieve the stresses for several hundred feet and parallel entries are not liable to have this same roof trouble.

It often happens that where this condition exists there is less trouble with the roof in wide entries than there is in narrow entries. This is because that in a wide entry the roof can sag further without fracturing. This extra sagging or bending allows greater movement of the stratum toward the entry. Thus, there might be sufficient movement to relieve the pressure without crushing the roof.

Those who attribute these forces to gas and water usually puncture the roof full of drillholes in an effort to draw off the gas and water and relieve the pressure.

I have seen this drilling done many times, but without success.

I would say drill the holes, then load them with dynamite and shoot the roof down. The sooner it is down, the less trouble there will be in the parallel entries.

S. E. DEBERRY

Dravosburg, Allegheny County, Pa.

Failure of Roof Strata Over Advanced Entries

Mr. DeBerry's letter dealing with the failure of roof strata over advanced entries is interesting and timely. For the general cases the manner of determining entry size, shape and support has been presented in a series of articles in your paper, [1, 2, 3, 4] to which reference may be made.

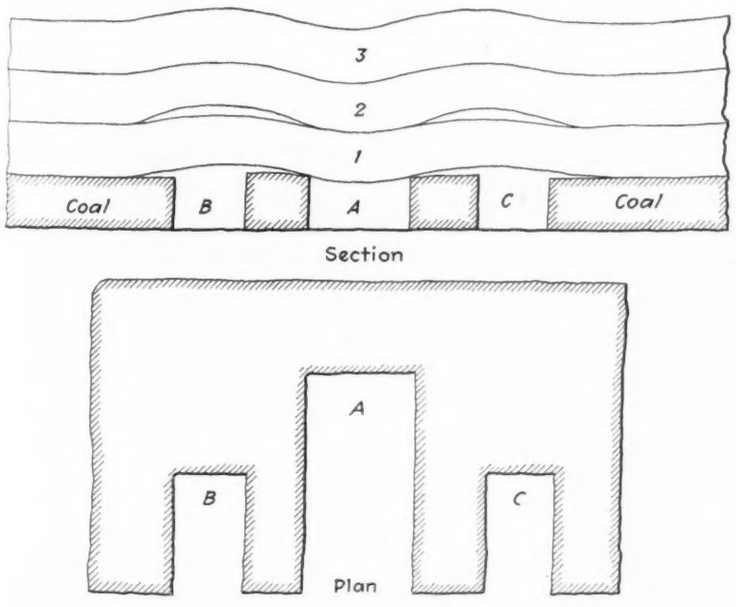
Mr. DeBerry presents two other cases, and solution arrived at full-scale field experiment which should be further discussed and studied, as their solution implies new concepts in the handling of these problems in the future. In one of these cases he refers to the fact that when two entries are driven, failure may occur only in the entry that is driven in advance. I am personally familiar with this condition and believe that this type of failure in one entry and not in another is due to the loading of the immediate roof stratum by the beds above it. This is illustrated in Fig. 1.

It may be noted that in entry *A*, the one driven in advance, the roof (*1*) is loaded by beds *2* and *3*. It may also be noted that in entries *B* and *C*, which were driven later, the mine roof is not loaded by beds *2* and *3* and will therefore stand. This tendency of strata to rise or have negative subsidence over solid coal has been observed in the field, probably first by Rutledge and has been obtained by barodynamic tests [5, 6] in the laboratory.

It is evident from the above sketch that the two additional openings, *B* and *C*, may be driven after *A* is driven, with relatively small support; or two entries *A* and *B* may be driven together and supported with no roof falls occurring if the procedure suggested in *Coal Age, October, 1938*,[2] is followed. To actually handle the problem and come to a decision as to what should be done in a district, at least an 8-in. core will be required of all strata to the surface and barodynamic tests run.

Mr. DeBerry's statement that less

Fig. 1—Roof behavior with one entry driven in advance (uplift exaggerated).



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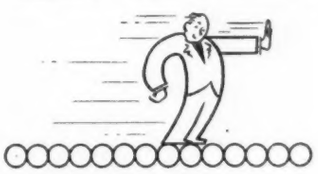

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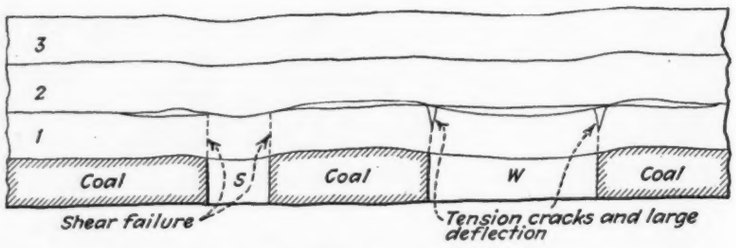


Fig. 2—Conditions for wide openings standing and narrow openings failing.

trouble sometimes occurs in wider than narrower entries is a repetition of a statement made to me by a highly regarded mine manager recently, which I questioned seriously at the time. Since getting back to my laboratory and checking our time effect and deflection curves on the behavior of geologic strata stressed beyond the elastic limits, I believe this condition possible. My present reasoning, therefore, is as follows:

Geologic conditions are as in Fig. 2, with beds *2*, *3* etc., loading roof *1* immediately over the coal. Beds *2*, *3*, etc., have structural characteristics which make it stronger in tension compression and shear than bed *1*. Bed *1* is relatively weak in shear, so that at a short-span (s) which may be calculated or determined by experiment it will fail in shear.

If the entry is driven wide (w), roof *1* will fail partially in tension and deflect away enough so that Beds *2* and *3* do not load it. Since beds *2* and *3* do not load the roof (*1*), it will not fail in shear, and experiments have shown that rock beams with partial failures in tension will stand up for long periods. For this condition a fine crack may be visible along the center line of the roof. Cracks in the roof top will be present but not visible over the ribs. Again the dimensions and procedure for this condition may be determined by barodynamic studies.

With reference to the effect of gas pressure, I have had several people inform me that it tended to break roof, but no satisfactory evidence has been made available. If gas were present in any quantity, the amount of surface available in mining for its release would soon decrease the pressure, so that its effects would be nil, as is evidenced in gusher oil and gas wells. The area for release of pressure in either an oil or gas well is small as compared to the areas available in the average coal mine.

The effects of water must be carefully considered. In the main and in the region in question water has little effect on the strength of mine roof strata. I have recently run some tests on Indiana State mine roof strata where this is not so. The roof stratum when dry is several times as strong as concrete in tension. If placed in water for half an hour it begins to disintegrate. If left in water for three days it becomes as soft as clay and will stand nothing. This mine required air-conditioning from the humidity standpoint, and by so doing has materially decreased difficulties with its roofs.

That horizontal pressures might cause roof difficulties is a reasonable hypothesis. If this were true, then a vertical shear in the mine roof in any place and parallel to the rib should provide all the release of pressure necessary. It may be tried by making a vertical shear cut in the entry face extending through the roof. Since most of the beds in this region are horizontally lying and since no large thrusts were acting on them (evidenced by slight folding), it may be reasoned that the horizontal forces acting on any bed before mining is done is due to the compression of that bed and Poisson's ratio for the material. This ratio is less than 1:4 and the horizontal forces are at the most one-quarter the vertical forces. When mining takes place beneath this bed (roof), there is no compression of the roof, not tendency to elongate because of Poisson's ratio, and consequently very little horizontal thrust. The horizontal thrust from the roof over the pillar is materially reduced by the fractional forces between the roof and the beds, above and below. If horizontal forces were large enough to be a determining factor, wider openings would always fail.

PHILIP B. BUCKY
Associate Professor of Mining
Columbia University.

[1] "Roof-Control Problems in High-Speed Mechanization," *Coal Age*, January, 1938, p. 61.

[2] "Roof Control Problems in Entries and Headings in Flat-Lying Seams," *Coal Age*, October, 1938, p. 33.

[3] "Roof Support for Openings in Pitching Seams," *Coal Age*, January, 1939, p. 38.

[4] "Roof Support at Faces in Flat and Pitching Seams," *Coal Age*, April, 1939, p. 58.

[5] "Effect of Artificial Support in Longwall Mining as Determined by Barodynamic Experiment," A.I.M.E. Tech. Paper 1020, pp. 10–12.

[6] "Effect of Immediate Roof Thickness in Longwall Mining as Determined by Barodynamic Experiment," A.I.M.E. Tech. Paper 946, p. 16.

"Shirt Sleeves to Shirt Sleeves"

I feel the anthracite industry is experiencing the result of "three generations from shirtsleeves to shirtsleeves," but instead of all getting down to shirtsleeves—as are some of the independents—some favor legislation to solve the problem; legislation which, when correctly understood, means curtailing tonnage and raising prices.

I fail to understand how our lost tonnage can be regained through such methods, and have been expecting someone to explain it through their trade paper. To me it would be just as sensible to ask for a law compelling all operators to stap in bed until 8 a.m., thereby holding back the shirtsleeve young men who now arise at 5:30 a.m.

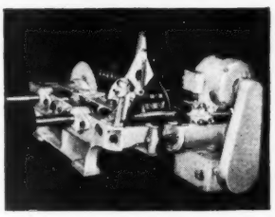
GEORGE F. LEE.

WHAT'S NEW

In Coal-Mining Equipment

HYDRAULIC CONTROL

Reeves Pulley Co., Columbus, Ind., announces a new and improved type of hydraulic automatic control for use with its variable-speed transmission. With the transmission as a basis, the control is said to provide entirely automatic speed regulation to make possible synchronization of different machines and separate sections of a single machine; maintenance of constant tension and peripheral winding speeds; and maintenance of uniform pressure, weight, liquid level, temperature and other variable elements.



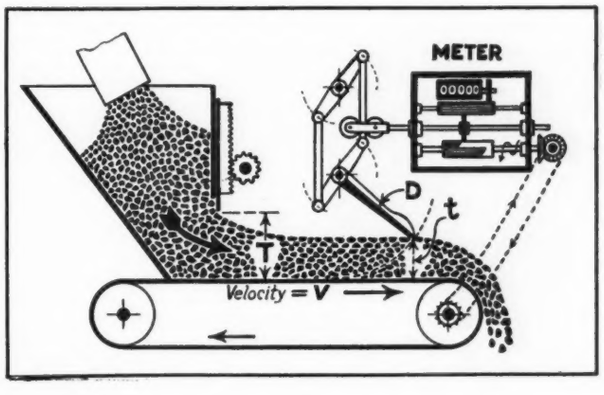
The control, according to the manufacturer, is simple and compact in design, with few working parts, and pressure of only 2 or 3 oz. will produce change in speed. From 6 to 20 seconds is required to shift the transmission from maximum to minimum speed, and vice versa, depending on size and ratio. The control is mounted at one end of the transmission frame.

COAL METERING

Automatic weighing of coal by measuring the volume flowing over a short conveying belt is made possible by the "Cubi-Meter," shown diagrammatically in the accompanying illustration. Inasmuch as the weight of coal per cubic foot is shown or can be determined, measuring the volume automatically determines the weight, it is stated by the manufacturer. A rigid plate is placed under the belt and two skirt boards are installed on either side, thus giving a rectangular cross-section of coal of varying depth, depending upon the feed from the hopper.

The metering element consists essentially of a train of four gears driven by a chain from a sprocket on the belt-driving shaft. One of these gears, as shown, has teeth all around it at one end and none at the other, while the intermediate section is partly toothed and partly not, grading from one end to the other. Thus, depending upon the position of the thin gear next to it, this thin gear will rotate continuously, part of the time or none of the time, in turn operating the meter only during the time of such rotation and thus recording the quantity of coal flowing over the belt.

The quantity of coal flowing of course, depends upon the depth on the belt. A swinging vane, *D*, rests on the coal and, by means of the rocker arms shown, changes the position of the thin gear next to the specially cut gear. As this thin gear is moved back and forth by the rising and falling vane it is driven a greater or lesser amount, or not at all, depending upon its position with relation to the specially cut driven gear. Thus, by means of the special gear and the vane and rocker arms, the meter is operated in direct ratio to the thickness of the coal on the conveyor. Consequently, it is pointed out, the weight of the coal can be directly determined. Further information may be obtained from J. F. Springer, 549 Riverside Drive, New York City.



STOCK BIN

A handy "Spin-A-Bin" in which to store screws, bolts, washers and other small parts is offered by the Noggle Products Co., Ann Arbor, Mich. With a ticket on the front of each compartment or a specimen wired to the front, it is recommended as a time and patience saver. A revolving assembly of welded steel bins in one compact unit, it is available with 24 bins each 3x3x2½ in. or 4x4x3 in.; in either model a double-width bin can be substituted for any pair of single-width compartments. Bins are 26-gage steel, spot-welded and finished in green.

UTILITY TRUCK

The Clark utility truck, just announced by the Clark Truck-tractor Division, Clark Equipment Co., Battle Creek, Mich., is built in six models, designed for the many handling operations in and about mining and other industrial plants. Designated as the "Stubby," it is a direct gas-powered, fork-type unit built in capacities of 2,000, 3,000 and 3,500 lb.

The forks have a tiering height of 60 in.; the minimum over-all height of the machine is about 59 in., providing the driver, who sits in the center behind the uprights, adequate forward vision. The unit is furnished with straight lift or tilting upright; it has a wheelbase of 38 in. and a turning radius of 67 in.

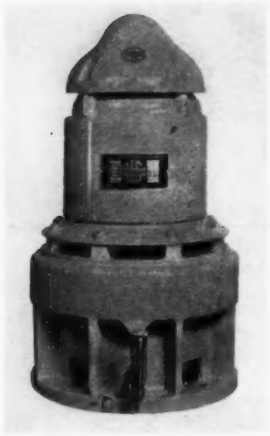
RETURN IDLER

For use on conveyor belts which handle abrasive, corrosive, damp or somewhat sticky materials, the Robins Conveying Belt Co., New York City, offers its Rubberdisc return idler. It is constructed of a steel-tube shaft on which are mounted a series of tough and resilient rubber disks spaced about 6 in. apart except at the ends, where the last two are about 3 in. apart. Within the tube are mounted lubricated-for-life ball bearings completely sealed against grit or moisture.

The resilient and flexible rubber disks and the open construction, with the belt supported at only a few points instead of its whole width, says the maker, makes it a self-cleaning unit.

VERTICAL MOTOR

A new vertical motor, the Syncrogear Type GDV, is offered by U. S. Electric Motors, Inc., Los Angeles, Calif. Especially designed to meet conditions peculiar to vertical operation, this unit incorporates a small geared oil pump which forces an ample supply of oil to bearings, gears and pinions. According to the



manufacturer, it is streamlined, compact and easily mounted.

TRANSMISSIONS WITH HANDWHEEL CONTROL

A new series of "Select-O-Speed" transmissions with handwheel control is announced by the Ideal Commutator Dresser Co., Sycamore, Ill. The new models supplement the standard line from fractional to 7½-hp. capacity that are equipped with lever-type control. The handwheel is recommended where finer speed adjustments and smaller increments of speed are necessary. By giving the wheel only a partial turn, according to the manufacturer, it is easy to change the speed only a few revolutions per minute.

This type of control, it is said, is especially desirable for installations requiring remote control: by replacing the handwheel with a set of beveled gears and extension rod and universal joint, the point of control may be taken to a more convenient location.

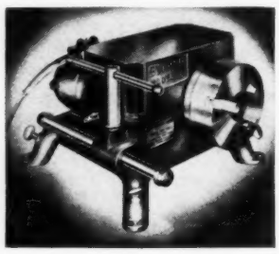
PORTABLE HOIST

A compact hoist of heavy-duty construction—the Comet—yet light in weight is offered by the Chisholm-Moore Hoist Corporation, Tonawanda, N. Y. Easily carried and installed by one man, according to the manufacturer, it is powered by a specially built heavy-duty, high-torque motor that runs on an ordinary light circuit or three-phase power line.

Precision ball bearings are provided at each rotating point; gears are precision-machined of heat-treated alloy steel; the controller, with patented "delayed reversing" feature, is said to operate easily with one hand and afford sensitive control for lifting even a fraction of an inch. The hoist is offered in four capacities: 250, 500, 750 and 1,000 lb., and several speeds; the 500-lb. size weighs 85 lb.

PORTABLE PIPE AND BOLT MACHINE

Beaver Pipe Tools, Inc., Warren, Ohio, announces the introduction of a new portable pipe and bolt machine, the Beaver Model C, which, according to the manufacturer, will thread pipe up to 2-in. size with solid full-width dies at a speed of about 22 r.p.m.; it will operate geared tools to thread pipe up to 8-in., with enough power to stop and start at the point of heaviest cutting, without undue strain.



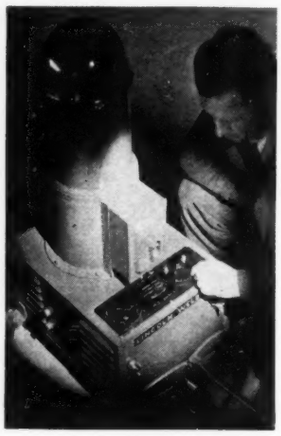
The gears are fully inclosed, the main driving gear running through a bath of oil—to reduce friction, heat, noise and wear. It has a conventional-type geared chuck which grips ¼- to 2-in. pipe and bolts from ¼-in. up; to tighten or loosen the chuck it is necessary only to turn the chuck wrench. The machine is designed for either bench or stand use, and two men can conveniently work at it—one threading and the other bending or making up fittings. Net weight of the bench unit is 140 lb.; height, 12½ in.; base, 18x18 in.; base dimensions mounted on legs, 42x46 in.

RESPIRATOR

Willson Products, Inc., Reading, Pa., announces a new low-resistance twin-filter respirator for protection against both Type A and lead dusts. Approved by the U. S. Bureau of Mines, this respirator, designated as No. 752L, employs a small rubber form-fitting face piece so designed as to permit the wearing of goggles or spectacles without visual interference. Two Rotiform filters, each with 30 sq.in. filtering surface, minimize breathing resistance.

SMALL ARC WELDER; ELECTRODES

A small motor-generator-type arc welder, said to provide convenience and accuracy in welding because of a self-indicating dual continuous current control, is announced by the Lincoln Electric Co., Cleveland, Ohio. Known as the "SA-150," it has both job selector and current control calibrated and equipped with dials which indicate the type of work and number of amperes for each and every setting.



With this development, it is said, the operator can vary both the slope of the volt-ampere curve and the amount of welding current independently and positively to suit every job encountered. Both voltage control and current control are continuous in operation, providing many possible combinations of voltage and current.

Power for the welder is supplied by a "Linc-Weld" squirrel-cage induction type motor for across-the-line starting. Connections are readily accessible for either 220 or 440 volts, three- or two-phase, 60 or 50 cycles, as desired. Construction is arc-welded drip-proof steel. Four steel feet welded to the base and drilled permit bolting the welder in stationary installations or attaching the optional three-wheeled running gear. Floor space required is less than 4 sq.ft.

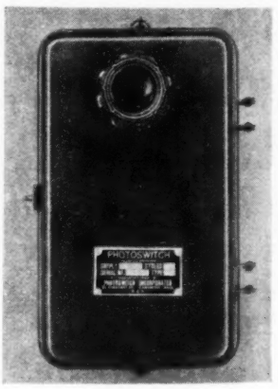
A new arc-welding electrode, known as "Readyweld," for use with a.c. transformer-type welders which have low open-circuit voltage also is offered by Lincoln. It is a low-carbon steel rod with heavy extruded shielded arc said to assure stability and easy restriking of the arc with small low-voltage transformer welders. It is intended for general welding and repair work on light-gage steel.

A new arc-welding electrode of the 18-8 type, having 3½ per cent molybdenum, designated "Stainweld C," also is available. With physical properties similar to 18-8 stainless steel, a coating is provided on the electrode which is said to prevent oxidation of the weld metal and keep the analysis of the deposited metal virtually the same as the parent metal.

SMOKE CONTROL BY ELECTRIC EYE

Electric-eye equipment for smoke control is announced by Photoswitch, Inc., Cambridge, Mass. Type A20C provides a method of indicating by bell or other signal located in the boiler room when smoke passing through the furnace flue exceeds a predetermined density, thus assuring good combustion and keeping within the limits of local smoke-code ordinances.

Simply and strongly constructed, according to the manufacturer, the unit includes a photo-electric control and light source supplied in dustproof, moistureproof housings, ready to install in any 110-volt a.c. circuit. Control and light source are mounted on opposite sides of the flue or chimney on rigid brackets. The light beam projects through a small opening in the flue across the inside of the flue, through a second opening to the eye of the control. The bell or light signal is located at any convenient point, and wired to the control housing.



A flame detector is available for industrial boilers as a safety device to indicate when the flame goes out. The company also offers a time totalizer for totalizing the time of inefficient combustion, to be located apart from and wired to the control.